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Question 1 of 131

A group of 60 patients with a history of medial epicondylitis is matched to a group of 60 control patients with no history of elbow problems. Thirty of the patients who've had medial epicondylitis had played golf before compared to only 10 in the control group.

What is the odds ratio of developing medial epicondylitis for people who play golf?

- A. 0.3
- B. 3
- ✓ C. 5
- D. 2.5
- E. 3.33

Next question

Question stats

33.5% of users answered this question correctly

Session score = 0%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Remeber to calculate the odds, rather than risk, initially:

Odds of patient with medial epicondylitis having played golf = 30 / 30 = 1

Odds of the control group having played golf = 10 / 50 = 0.2

The odds ratio therefore = 1 / 0.2 = 5

Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

Rate question:

Next question

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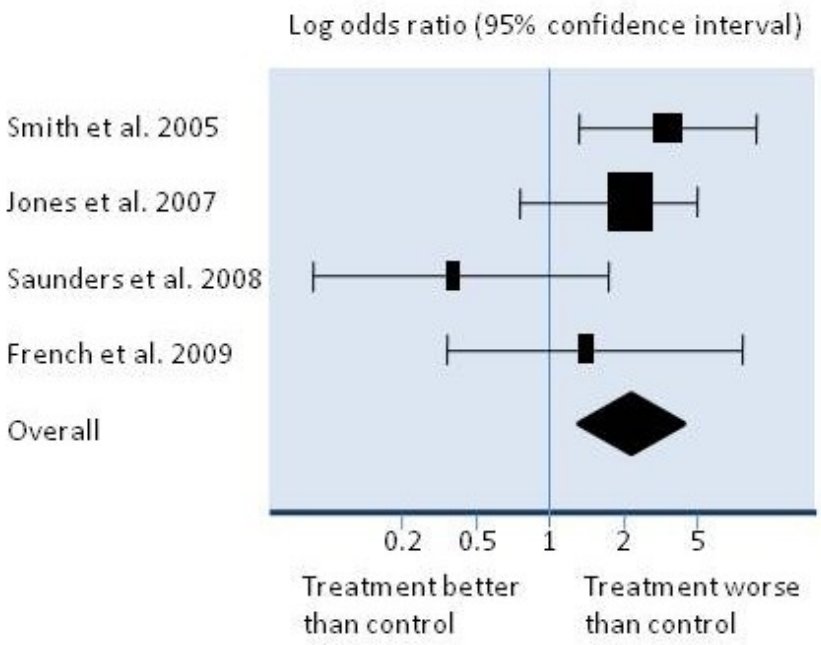
Question 2 of 131

A meta-analysis examines whether giving a new dietary supplement to patients who've recently had a myocardial infarction can help prevent a further attack. The meta-analysis consists of four randomised controlled trials and is summarised below:



What is the most appropriate interpretation of the data?

- A. There is publication bias in studies looking into this question
- B. There is a non-significant trend that taking the supplement reduces the chance of a further myocardial infarctions
- C. There is a non-significant trend towards no benefit from taking the supplement in terms of reducing further myocardial infarctions
- D. Taking the supplement reduces the chance of a further myocardial infarctions
- ✓ E. Taking the supplement increases the chance of a further myocardial infarction

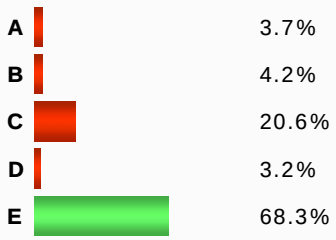
Next question

The meta-analysis of the results, represented by the diamond, is clear from the no effect line (odds ratio of 1) and shows a significant increase in the chance of a further myocardial infarction.

Forest plots

Forest plots are usually found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials.

Question stats



68.3% of users answered this question correctly

Session score = 0%

RCGP curriculum

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Curriculum statement

The name of the trials is listed down the left hand side, usually in chronological order. On the right hand side the results of the studies are shown as squares centred on the point estimate of the result of each trial. The size of the square is proportional to the weight of the study in the meta-analysis. The line running through the square shows the confidence interval, usually at 95%. Beneath the individual trials is the summary result (i.e. The result of the meta-analysis) represented by a diamond.

Rate question:

Next question

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Question 3 of 131

As part of a research project you are trying to ascertain whether the use of dummies in infants is linked to sudden infant death syndrome. What is the most appropriate form of study design?

- A. Randomised controlled trial
- B. Cross-over trial
- C. Cross-sectional survey
- ✓ D. Case-control study
- E. Cohort study

Next question

As sudden infant death syndrome is relatively rare a case-control design is more appropriate than a cohort study.

Question stats

A	8.8%
B	0.9%
C	9.3%
D	50.8%
E	30.3%

50.8% of users answered this question correctly

Session score = 0%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

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Question 4 of 131

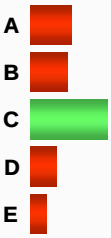
You are reviewing a new study on the benefit of omega-3 fish oils in patients with established ischaemic heart disease. What does the power of the study equate to?

- A. = 1 / p value
- B. = standard deviation / square root of sample size
- ✓ C. = 1 - probability of making a type II error
- D. = 1 - probability of making a type I error
- E. = 1 / probability of making a type I error

Next question

Power = 1 - the probability of a type II error

Question stats



38.6% of users answered this question correctly

Session score = 0%

RCGP curriculum

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Curriculum statement

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size

and alpha

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)
Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

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Question 5 of 131

A rapid finger-prick blood test to help diagnosis deep vein thrombosis is developed. Comparing the test to current standard techniques a study is done on 1,000 patients:

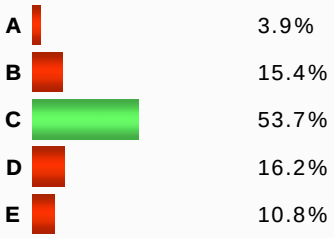
	DVT present	DVT absent
New test positive	200	100
New test negative	20	680

What is the specificity of the new test?

- A. 680/880
- B. 200/220
- C. 680/780 ✓
- D. 680/700
- E. 200/300

Next question

Question stats



53.7% of users answered this question correctly

Session score = 0%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Specificity = true negatives / (true negatives + false positives)

= 680 / (680 + 100)

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 6 of 131

A new oral-hypoglycaemic is being developed. A number of different study types are considered to demonstrate efficacy in reducing the HbA1c. Which one of the following study designs would require the most patients to produce a significant result?

- A. Equivalence trial
- B. Non-inferiority trial
- ✓ C. Superiority trial
- D. Placebo-controlled trial
- E. Study design would not affect the number of patients required

Next question

As a superiority trial compares the new drug with an existing treatment, which would also lower HbA1c, a large sample size is required to demonstrate a significant difference.

Study design: new drugs

When a new drug is launched there are a number of options available in terms of study design. One option is a placebo controlled trial. Whilst this may provide robust evidence it may be considered unethical if established treatments are available and it also does not provide a comparison with standard treatments.

If a drug is therefore to be compared to an existing treatment a statistician will need to decide whether the trial is intended to show superiority, equivalence or non-inferiority:

- superiority: whilst this may seem the natural aim of a trial one problem is the large sample size needed to show a significant benefit over an existing treatment
- equivalence: an equivalence margin is defined (-delta to +delta) on a specified outcome. If the confidence interval of the difference between the two drugs lies within the equivalence margin then the drugs may be assumed to have a similar effect
- non-inferiority: similar to equivalence trials, but only the lower confidence interval needs to lie within the equivalence margin (i.e. -delta). Small sample sizes are needed for these trials. Once a drug has been shown to be non-inferior large studies may be performed to show superiority

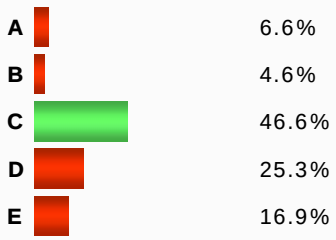
It should be remembered that drug companies may not necessarily want to show superiority over an existing product. If it can be demonstrated that their product is equivalent or even non-inferior then they may compete on price or convenience.

Rate question:

Next question

Comment on this question

Question stats



46.6% of users answered this question correctly

Session score = 0%

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Curriculum statement

External links

European Medicines Agency
Further information on trial design

passmedicine.com

Questions 7 to 9 of 131

Theme: Statistical terms: descriptive statistics

A 1
B 2
C 3
D 4
E 5
F 6
G 7
H 8
I 9
J 10

You are reviewing the case notes of seven patients who have COPD. You record the number of exacerbations they have had in the past year as follows:
1,0,1,5,4,2,1

7. What is the mode?

1

8. What is the mean?

1

The correct answer is 2

9. What is the median value?

1

Next question

Question stats

Average score for registered users:

7 89.8%
8 79.5%
9 71.9%

Session score = 22.2%

RCGP curriculum

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Curriculum statement

Statistical terms: descriptive statistics

The table below gives a brief definition of commonly encountered terms:

Term	Description
Mean	The average of a series of observed values
Median	The middle value if series of observed values are placed in order
Mode	The value that occurs most frequently within a dataset
Range	The difference between the largest and smallest observed value

Rate question:

Next question

Comment on this question

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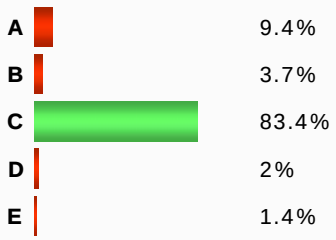
Question 10 of 131

You have been asked to investigate the potential benefit of setting up a service to help patients with multiple sclerosis in the local area. What is the most important factor when determining how many resources will be required?

- A. Incidence
- B. Bayesian factor
- ✓ C. Prevalence
- D. Denominator data
- E. P value

Next question

Question stats



83.4% of users answered this question correctly

Session score = 20%

Incidence and prevalence

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These two terms are used to describe the frequency of a condition in a population.

The **incidence** is the number of new cases per population in a given time period.

For example, if condition X has caused 40 new cases over the past 12 months per 1,000 of the population the annual incidence is 0.04 or 4%.

The **prevalence** is the total number of cases per population at a particular point in time.

For example, imagine a questionnaire is sent to 2,500 adults asking them how much they weigh. If from this sample population of 500 of the adults were obese then the prevalence of obesity would be 0.2 or 20%.

Relationship

- prevalence = incidence * duration of condition
- in chronic diseases the prevalence is much greater than the incidence
- in acute diseases the prevalence and incidence are similar. For conditions such as the common cold the incidence may be greater than the prevalence

Rate question:

Next question

Comment on this question

Question 11 of 131

A study is carried out to assess the potential of hip protectors to reduce femoral neck fractures in elderly nursing home patients. The average age of the patients was 82 years. Over a two-year period 800 patients were recruited and assigned randomly either to the hip protector group or standard care group.

The results:

Hip protector group: 400 patients - 10 of whom had a femoral neck fracture over the two year period

Control group: 400 patients - 20 of whom had a femoral neck fracture over the two year period

What is the absolute risk reduction?

- A. 0.025
- B. 0.05
- C. 2
- D. 10
- E. 0.5

Next question

Question stats

A	43.4%
B	7.5%
C	13.9%
D	12.7%
E	22.4%

43.4% of users answered this question correctly

Session score = 18.2%

RCGP curriculum

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Curriculum statement

Absolute risk reduction = (Control event rate) - (Experimental event rate)

The absolute risk reduction = CER-EER, where:

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

CER = 20 / 400 = 1 / 20 = 0.05
EER = 10 / 400 = 1 / 40 = 0.025

ARR = CER - EER = 0.05 - 0.025 = 0.025

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the

intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

Comment on this question

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Question 12 of 131

A new drug designed to prevent exacerbations of genital herpes undergoes clinical trials. One hundred patients are given the new drug. During a three month period 10 of the patients have an episode of genital herpes. In the control group there are 300 patients who are given a placebo. In this group 50 people have an exacerbation during the same time period. What is the relative risk of having an exacerbation of genital herpes whilst taking the new drug?

- A. 0.8
- B. 0.2
- C. 1.66
- ✓ D. 0.6
- E. 0.06

Next question

Question stats

A	6.1%
B	11.6%
C	14.3%
D	56%
E	12%

56% of users answered this question correctly

Session score = 16.7%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Experimental event rate, EER = 10 / 100 = 0.10

Control event rate, CER = 50 / 300 = 0.166

Therefore the relative risk = EER / CER = 0.1 / 0.166 = 0.6

Relative risk

Relative risk (RR) is the ratio of risk in the experimental group (experimental event rate, EER) to risk in the control group (control event rate, CER)

To recap

- EER = rate at which events occur in the experimental group
- CER = rate at which events occur in the control group

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Experienced significant pain relief
Paracetamol	100	60
Placebo	80	20

Experimental event rate, EER = 60 / 100 = 0.6

Control event rate, CER = 20 / 80 = 0.25

Therefore the relative risk = EER / CER = 0.6 / 0.25 = 2.4

If the risk ratio is > 1 then the rate of an event (in this case experiencing significant pain relief) is increased compared to controls. It is therefore

appropriate to calculate the relative risk increase if necessary (see below).

If the risk ratio is < 1 then the rate of an event is decreased compared to controls. The relative risk reduction should therefore be calculated (see below).

Relative risk reduction (RRR) or **relative risk increase (RRI)** is calculated by dividing the absolute risk change by the control event rate

Using the above data, RRI = (EER - CER) / CER = (0.6 - 0.25) / 0.25 = 1.4 = 140%

Rate question:

Next question

Comment on this question

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Question 13 of 131

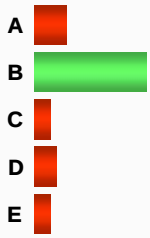
What are funnel plots primarily used for?

- A. Demonstrate the heterogeneity of a meta-analysis
- ✓ B. Demonstrate the existence of publication bias in meta-analyses
- C. Provide a graphical representation of the relative risk results in a case-control study
- D. Provide a graphical representation of the relative risk results in a cohort study
- E. Provide a graphical representation of the probability of a patient experiencing a particular adverse effect

Next question

Funnel plots - show publication bias in meta-analyses

Question stats



57.2% of users answered this question correctly

Session score = 15.4%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Funnel plot

A funnel plot is primarily used to demonstrate the existence of publication bias in meta-analyses. Funnel plots are usually drawn with treatment effects on the horizontal axis and study size on the vertical axis.

Interpretation

- a symmetrical, inverted funnel shape indicates that publication bias is unlikely
- conversely, an asymmetrical funnel indicates a relationship between treatment effect and study size. This indicates either publication bias or a systematic difference between smaller and larger studies ('small study effects')

Rate question:

Next question

Comment on this question

Question 14 of 131

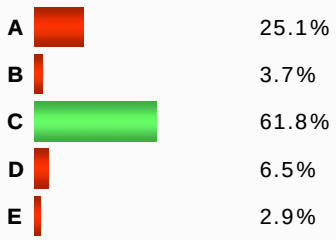
A cohort study is being designed to look at the relationship between smoking and breast cancer. What is the usual outcome measure in a cohort study?

- A. Odds ratio
- B. Experimental event rate
- ✓ C. Relative risk
- D. Absolute risk increase
- E. Numbers needed to harm

Next question

Cohort studies - relative risk

Question stats



61.8% of users answered this question correctly

Session score = 14.3%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

Comment on this question

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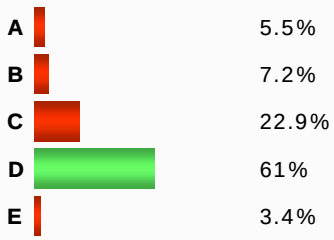
Question 15 of 131

Which one of the following statements best describes a type II statistical error?

- A. The p value fails to reach statistical significance
- B. A study fails to reach an appropriate power
- C. The null hypothesis is rejected when it is true
- ✓ D. The null hypothesis is accepted when it is false
- E. The alternative hypothesis is rejected when it is false

Next question

Question stats



61% of users answered this question correctly

Session score = 13.3%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)

Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

Comment on this question

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Questions 16 to 18 of 131

Theme: Graphical representations of statistical data

A Forest plot
B Funnel plot
C Box plot
D Histogram
E Box-and-whisker plot
F Bar chart
G Stem plot
H Pearson survival plot
I Kaplan-Meier survival plot
J Scatter plot

Please match each one of the following descriptions to the appropriate type of graph:

16. A plot of the estimate of a patient's survival showing decreasing survival with time

Forest plot

The correct answer is Kaplan-Meier survival plot

17. A graphical display of continuous data where the values have been categorised into a number of categories

Forest plot

The correct answer is Histogram

18. Used to demonstrate the existence of publication bias in meta-analyses

Forest plot

The correct answer is Funnel plot

Next question

Question stats

Average score for registered users:

16	44.8%
17	49.1%
18	73.7%

Session score = 11.1%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Graphical representations of statistical data

The table below gives a brief summary of the main types of graphs used to represent statistical data.

Box-and-whisker plot	Graphical representation of the sample minimum, lower quartile, median, upper quartile and sample maximum
Funnel plot	Used to demonstrate the existence of publication bias in meta-analyses
Histogram	A graphical display of continuous data where the values have been categorised into a number of categories
Forest plot	Forest plots are usually found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials
Scatter plot	Graphical representation using Cartesian coordinates to display values for two variables for a set of data
Kaplan-Meier survival plot	A plot of the Kaplan-Meier estimate of the survival function showing decreasing survival with time

Rate question:

Next question

Comment on this question

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Question 19 of 131

Which one of the following defines the standard error of the mean?

- A. Square root (Standard deviation / number of patients)
- B. Number of patients / square root (mean)
- C. Number of patients / square root (standard deviation)
- ✓ D. Standard deviation / square root (number of patients)
- E. Standard deviation / square root (mean)

Next question

Standard error of the mean = standard deviation / square root (number of patients)

Question stats

A	12.7%
B	6.7%
C	11.4%
D	47.4%
E	21.8%

47.4% of users answered this question correctly

Session score = 10.5%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Standard error of the mean

The standard error of the mean (SEM) is a measure of the spread expected for the mean of the observations - i.e. how 'accurate' the calculated sample mean is from the true population mean

Key point

- SEM = SD / square root (n)
- where SD = standard deviation and n = sample size

Therefore the SEM gets smaller as the sample size (n) increases

A confidence interval for the mean can be calculated in a similar way to that for a single observation, i.e. The 95% confidence interval:

- lower limit = mean - (1.96 *SEM)
- upper limit = mean + (1.96 * SEM)

Rate question:

Next question

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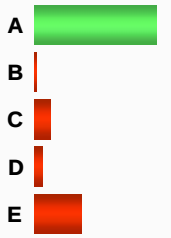
Question 20 of 131

You are performing a study of blood pressure readings in patients with chronic kidney disease. Assuming that the results are normally distributed, what percentage of values lie within two standard deviations of the mean blood pressure reading?

- ✓ A. 95.4%
- B. 5.3%
- C. 98.3%
- D. 10%
- E. 97.5%

Next question

Question stats



62.4% of users answered this question correctly

Session score = 10%

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Rate question:

Next question

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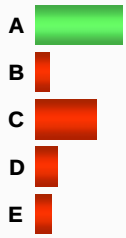
Question 21 of 131

A case-control study is designed to investigate whether being exposed to passive smoking as a child is a risk factor for asthma. Two hundred patients with asthma are recruited. Of these 200, 40 report either one or both parents smoking in the house when they were a child. A further 200 controls who do not have asthma are recruited. Of these people 20 report that one or both parents smoked in the house. What is the odds ratio of developing asthma after being exposed to passive smoking as a child?

- A. 2.25 ✓
- B. 0.66
- C. 0.5
- D. 1.5
- E. 4

Next question

Question stats



43.9% of users answered this question correctly

Session score = 9.5%

Odds - remember a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome

NOT a ratio of the number of people who incur a particular outcome to the total number of people

RCGP curriculum

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Curriculum statement

The odds of asthmatics being exposed to passive smoking is 40 / 160 = 1 / 4

The odds of the controls being exposed to passive smoking is 20 / 180 = 1 / 9

The odds ratio is therefore 1/4 / 1/9 = 9/4 = 2.25

Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

Rate question:

Next question

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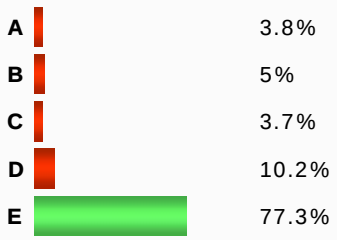
Question 22 of 131

A new test to screen for pulmonary embolism (PE) is used in 100 patients who present to the Emergency Department. The test is positive in 30 of the 40 patients who are proven to have a PE. Of the remaining 60 patients, only 5 have a positive test. What is the sensitivity of the new test?

- A. 8.33%
- B. 30%
- C. 40%
- D. 66.66%
- ✓ E. 75%

Next question

Question stats



77.3% of users answered this question correctly

Session score = 9.1%

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Curriculum statement

A contingency table can be constructed from the above data, as shown below:

	PE diagnosed	No PE
Test positive	30	5
Test negative	10	55

The sensitivity is therefore 30 / (30 + 10) = 75%

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 23 of 131

Which one of the following may be used to calculate the number needed to treat?

- A. 1 / (Absolute risk reduction) ✓
- B. (Absolute Risk Reduction) / (Number of people in trial)
- C. ((Control event rate) - (Experimental event rate)) / (Control event rate)
- D. 1 / (Relative risk)
- E. 1 / (Hazard ratio)

Next question

NNT = 1 / (CER - EER), or 1 / Absolute Risk Reduction

Question stats

A	73.2%
B	8.8%
C	8.7%
D	8.5%
E	0.8%

73.2% of users answered this question correctly

Session score = 8.7%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

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Question 24 of 131

A study compares the sensitivity of two tests for colorectal cancer. The first test has a sensitivity of 85% whilst the second test has a sensitivity of 91%. What type of significance test should be used for comparing the two results?

- A. Wilcoxon matched-pairs
- B. Mann-Whitney test
- C. Student's t-test
- ✓ D. Chi-squared test
- E. Pearson's test

Next question

As percentages are being compared the chi-squared test should be used

Question stats

A	6%
B	9.8%
C	18.7%
D	56.2%
E	9.4%

56.2% of users answered this question correctly

Session score = 8.3%

RCGP curriculum

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Curriculum statement

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

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Questions 25 to 27 of 131

Theme: Screening test statistics

A TN / (TN + FN)
B TP / (TP + FN)
C Sensitivity / (1 - specificity)
D TP / (TP + FP)
E TN / (TN + FP)
F (1 - sensitivity) / specificity

For each one of the following statistical terms listed below select the correct equation

TP = true positive; FP = false positive; TN = true negative; FN = false negative

25. Sensitivity

TN / (TN + FN)

The correct answer is TP / (TP + FN)

26. Positive predictive value

TN / (TN + FN)

The correct answer is TP / (TP + FP)

27. Specificity

TN / (TN + FN)

The correct answer is TN / (TN + FP)

Next question

Question stats

Average score for registered users:

25	75.5%
26	72.1%
27	68.7%

Session score = 7.4%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 28 of 131

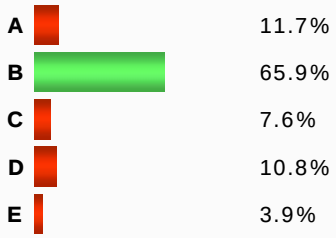
Which one of the following statements regarding relative risk is correct?

- A. Relative risk = 1 - absolute risk reduction
- ✓ B. It is the usual outcome measure of cohort studies
- C. Risk may be defined as the odds of an outcome happening
- D. Relative risk = 1 / odds ratio
- E. If the risk ratio is less than 1 then the rate of an event is increased compared to controls

Next question

Remember that risk and odds are different. If 20 patients die out of every 100 who have a myocardial infarction then the risk of dying is 20 / 100 = 0.2 whereas the odds are 20 / 80 = 0.25.

Question stats



65.9% of users answered this question correctly

Session score = 7.1%

RCGP curriculum

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Curriculum statement

Relative risk

Relative risk (RR) is the ratio of risk in the experimental group (experimental event rate, EER) to risk in the control group (control event rate, CER)

To recap

- EER = rate at which events occur in the experimental group
- CER = rate at which events occur in the control group

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Experienced significant pain relief
Paracetamol	100	60
Placebo	80	20

Experimental event rate, EER = 60 / 100 = 0.6

Control event rate, CER = 20 / 80 = 0.25

Therefore the relative risk = EER / CER = 0.6 / 0.25 = 2.4

If the risk ratio is > 1 then the rate of an event (in this case experiencing significant pain relief) is increased compared to controls. It is therefore appropriate to calculate the relative risk increase if necessary (see below).

If the risk ratio is < 1 then the rate of an event is decreased compared to controls. The relative risk reduction should therefore be calculated (see below).

Relative risk reduction (RRR) or **relative risk increase (RRI)** is calculated by dividing the absolute risk change by the control event rate

Using the above data, RRI = (EER - CER) / CER = (0.6 - 0.25) / 0.25 = 1.4 = 140%

Rate question:

Next question

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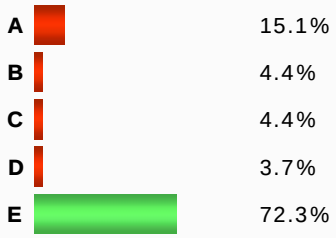
Question 29 of 131

Which one of the following statements regarding the standard error of the mean is correct?

- A. Is the square root of standard deviation
- B. It is independent of sample size
- C. Is a measure of correlation between two variables
- D. Confidence intervals cannot be applied to the standard error of the mean
- ✓ E. Gets smaller as the sample size increases

Next question

Question stats



72.3% of users answered this question correctly

Session score = 6.9%

Standard error of the mean

The standard error of the mean (SEM) is a measure of the spread expected for the mean of the observations - i.e. how 'accurate' the calculated sample mean is from the true population mean

Key point

- SEM = SD / square root (n)
- where SD = standard deviation and n = sample size

Therefore the SEM gets smaller as the sample size (n) increases

A confidence interval for the mean can be calculated in a similar way to that for a single observation, i.e. The 95% confidence interval:

- lower limit = mean - (1.96 *SEM)
- upper limit = mean + (1.96 * SEM)

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Curriculum statement

Rate question:

Next question

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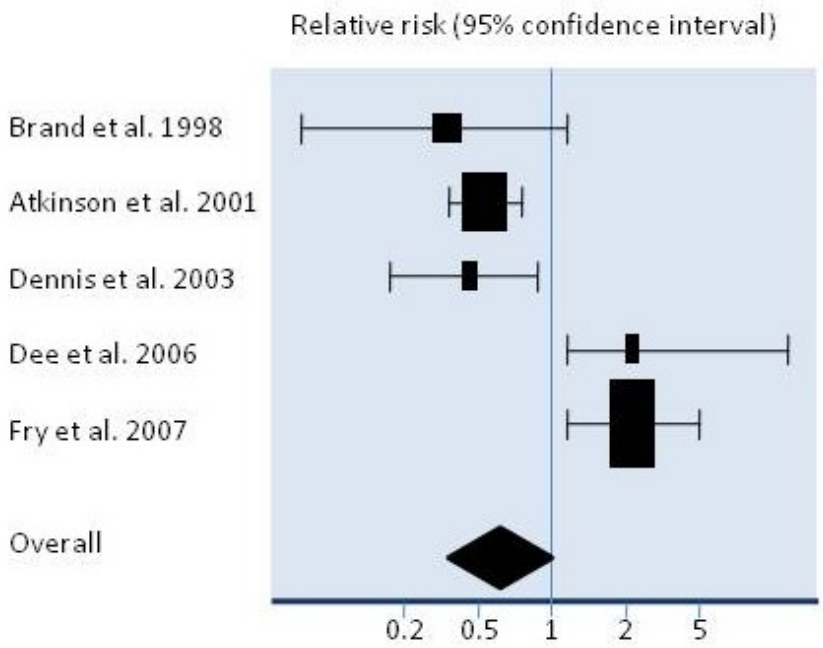
Question 30 of 131

A meta-analysis looks at five studies which investigate the link between a new drug and upper gastrointestinal bleeding. All the studies report the relative risk of developing an upper gastrointestinal bleed compared to a control population.



Which one of the studies provides the strongest evidence that the new drug does not cause gastrointestinal bleeding?

- A. Dennis et al
- B. Dee et al
- ✓ C. Atkinson et al
- D. Fry et al
- E. Brand et al

Next question

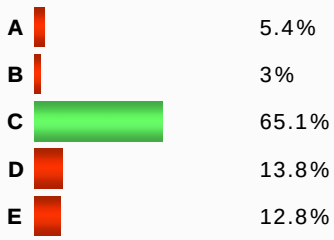
The study by Atkinson et al is significant as it does not cross the line equating to a relative risk of 1. The large square and narrow confidence interval indicates a large, well powered study.

Forest plots

Forest plots are usually found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials.

The name of the trials is listed down the left hand side, usually in chronological order. On the right hand side the results of the studies are shown as squares

Question stats



65.1% of users answered this question correctly

Session score = 6.7%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

centred on the point estimate of the result of each trial. The size of the square is proportional to the weight of the study in the meta-analysis. The line running through the square shows the confidence interval, usually at 95%. Beneath the individual trials is the summary result (i.e. The result of the meta-analysis) represented by a diamond.

Rate question:

Next question

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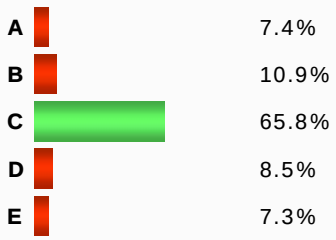
Question 31 of 131

A new drug is trialled for the treatment of lung cancer. Drug A is given to 500 people with early stage non-small cell lung cancer and a placebo is given to 450 people with the same condition. After 5 years 300 people who received drug A had survived compared to 225 who received the placebo. What is the number needed to treat to save one life?

- A. 3.33
- B. 75
- C. 10 ✓
- D. 5
- E. 2

Next question

Question stats



65.8% of users answered this question correctly

Session score = 6.5%

NNT = 1 / (CER - EER), or 1 / Absolute Risk Reduction

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

The question asks about the number needed to treat to save one life. The 'event' is therefore survival.

Experimental (drug A) event rate = 300 / 500 = 0.6
Control (placebo) event rate = 225 / 450 = 0.5

Absolute risk reduction = 0.6 - 0.5 = 0.1
Number needed to treat = 1 / 0.1 = 10

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

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Question 32 of 131

Which one of the following is the best definition of the p value?

- A. The probability of obtaining a similar result, assuming that the null hypothesis is true
- B. The probability that a replicating experiment would not yield the same conclusion
- ✓ C. The probability of obtaining a result at least as extreme, assuming that the null hypothesis is true
- D. The probability that the null hypothesis is true
- E. The probability of obtaining a result at least as extreme, assuming that the null hypothesis is false

Next question

Question stats

A	17%
B	3.3%
C	42.1%
D	21.1%
E	16.5%

42.1% of users answered this question correctly

Session score = 6.3%

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)
Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

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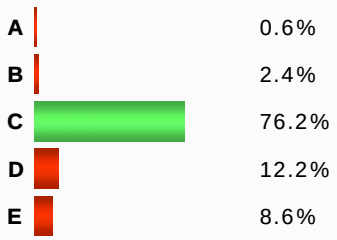
Question 33 of 131

A randomised controlled trial compares two drugs used in the initial management of rheumatoid arthritis. After being assigned to the randomised groups a number of patients drop out due to adverse effects of the medication. How should the data be analysed?

- A. Recruit more patients
- B. For each patient who drops out, remove a patient from the other randomised group
- ✓ C. Include the patients who drop out in the final data set
- D. Remove patients who drop out from final data set
- E. Abandon the trial if more than 5% of patients drop out

Next question

Question stats



76.2% of users answered this question correctly

Session score = 6.1%

Intention to treat analysis

Intention to treat analysis is a method of analysis for randomized controlled trials in which all patients randomly assigned to one of the treatments are analysed together, regardless of whether or not they completed or received that treatment

Intention to treat analysis is done to avoid the effects of crossover and drop-out, which may affect the randomization to the treatment groups

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Curriculum statement

Rate question:

Next question

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Questions 34 to 36 of 131

Theme: Seminal trials: lipid management

A WOSCOPS
B UKPDS
C Heart Protection Study
D Million Women Study
E SCOPE
F CARE
G The 4S trial
H STOP-2

For each one of the following please select the relevant trial:

34. Demonstrated that antioxidants were of no benefit in preventing cardiovascular disease

WOSCOPS

The correct answer is Heart Protection Study

35. Demonstrated a 30% reduction in all cause mortality in patients who had a history of ischaemic heart disease who were given simvastatin

WOSCOPS

The correct answer is The 4S trial

36. Showed that pravastatin was beneficial in the primary prevention of ischaemic heart disease

WOSCOPS

Next question

Question stats

Average score for registered users:

34	48%
35	41.4%
36	40.6%

Session score = 8.3%

RCGP curriculum

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Curriculum statement

Key trials: lipid management

The following table summarises some of the key trials which have altered the approach to lipid management:

The 4S trial	The 1994 Scandinavian Simvastatin Survival Study was a double-blinded randomised controlled trial looking at the secondary prevention of cardiovascular disease. Patients who had ischaemic heart disease and a cholesterol between 5.5 and 8.0 mmol/l were given either simvastatin or a placebo. Main results • total mortality decreased by 30% with death related to ischaemic heart disease decreased by 42% • no increase in non-cardiovascular death
WOSCOPS	The 1995 West of Scotland Coronary Prevention Study was a randomised controlled trial of men aged 45-64 years with no history of ischaemic heart disease and with a raised cholesterol (> 6.5 mmol/l). Participants were given either pravastatin or a placebo. Main results • total mortality decreased by 22% with death related to ischaemic heart disease decreased by 31%
Heart Protection Study	A large randomised controlled trial of just over 20,000 patients funded by the Medical Research Council. Initial results were published in 2002. Patients were included if they were between 40 - 80 years and were considered to have a substantial 5-year risk of death from ischaemic heart disease due to a history of vascular disease or risk factors such as diabetes or hypertension. Patients were randomly allocated either simvastatin 40mg, antioxidants (600 mg vitamin E, 250 mg vitamin C and 20 mg beta-carotene daily), placebo or a combination. Main results • number needed to treat (NNT) to prevent all cause death = 57, NNT to prevent death related to ischaemic heart disease = 85 • NNT to prevent a vascular event = 19, NNT to prevent a major coronary event = 33, NNT to prevent a stroke = 73 • vascular events were reduced by around 25% • antioxidants did not affect clinical outcome

Rate question:

Next question

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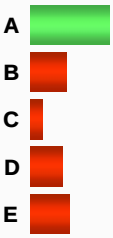
Question 37 of 131

A study looks at the chance of having a myocardial infarction (MI) in patients with known ischaemic heart disease. Group A are given standard treatment. After 5 years 20 of the 100 patients have had a MI. Group B have standard treatment plus a new cardiac drug. After 5 years 10 of the 60 patients have had an MI. What is the odds ratio of having a MI whilst taking the new drug compared to those who do not?

- A. 0.8
- B. 0.83
- C. 2
- D. 1.2
- E. 1.25

Next question

Question stats



39.6% of users answered this question correctly

Session score = 8.1%

Odds - remember a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome

NOT a ratio of the number of people who incur a particular outcome to the total number of people

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Odds of MI in group B = 10/50 = 1/5

Odds of MI in group A = 20/80 = 1/4

Odds ratio of having a MI = 1/5 divided by 1/4 = 0.8

Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

Rate question:

Next question

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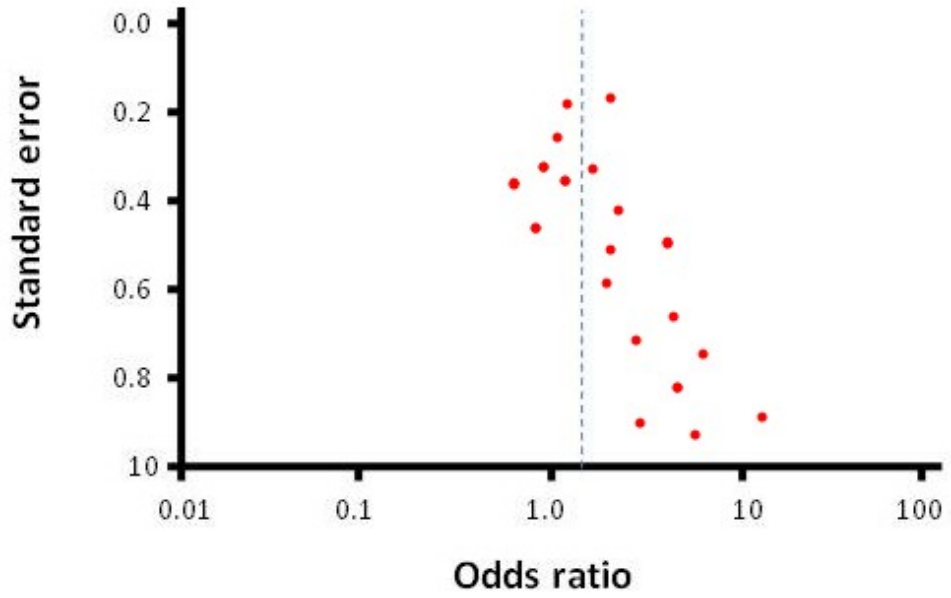
Question 38 of 131

A meta-analysis looks at the benefit of prokinetic agents in patients with gastro-oesophageal reflux disease (GORD). The data from the 19 trials is represented in the diagram below:



What conclusions can be drawn from this diagram?

- A. None of the studies were statistically significant
- B. There is a positive correlation between study size and the clinical benefit from prokinetics
- C. The results of the smaller trials were falsified
- D. Six of the studies showed no benefit from prokinetics in GORD
- ✓ E. There is publication bias in some studies looking at the use of prokinetics in GORD

Next question

The asymmetrical nature of this funnel plot indicates publication bias.

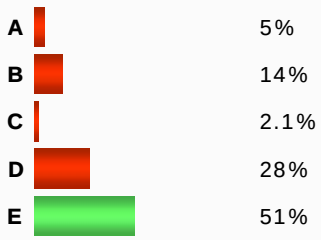
Funnel plot

A funnel plot is primarily used to demonstrate the existence of publication bias in meta-analyses. Funnel plots are usually drawn with treatment effects on the horizontal axis and study size on the vertical axis.

Interpretation

- a symmetrical, inverted funnel shape indicates that publication bias is unlikely

Question stats



51% of users answered this question correctly

Session score = 7.9%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

- conversely, an asymmetrical funnel indicates a relationship between treatment effect and study size. This indicates either publication bias or a systematic difference between smaller and larger studies ('small study effects')

Rate question:

Next question

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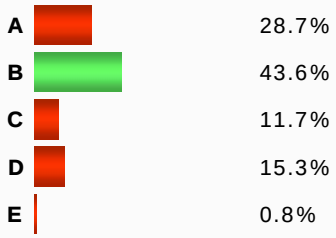
Question 39 of 131

An endocrinologist performs a study to assess whether a patient's HbA1c level is correlated to their LDL level. Assuming both HbA1c and LDL are normally distributed, which one of the following statistical tests is it most appropriate to perform?

- A. Chi-squared test
- ✓ B. Pearson's product-moment coefficient
- C. Mann-Whitney test
- D. Spearman's rank correlation coefficient
- E. McNemar's test

Next question

Question stats



43.6% of users answered this question correctly

Session score = 7.7%

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Curriculum statement

Correlation

- parametric (normally distributed): Pearson's coefficient
- non-parametric: Spearman's coefficient

Pearson's product-moment coefficient test is most appropriate as the data is parametric and the study is assessing the correlation of two variables

McNemar's test is a non-parametric method used on nominal data to determine whether the row and column marginal frequencies are equal

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two

different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

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Question 40 of 131

A study is to be performed to assess whether the combined oral contraceptive pill is protective against pelvic inflammatory disease. What is the most appropriate type of study design to provide robust evidence?

- A. Cohort study
- B. Placebo-controlled randomised controlled trial
- C. Case-control study
- D. Cross-sectional survey
- E. Cross-over trial

Next question

Whilst a case-control study may be used it would provide inferior evidence to that of a cohort study. It is of course not ethical to give women placebo contraceptive pills, as would be required with a randomised control trial

Study design

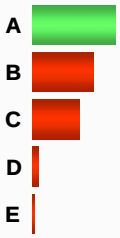
The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

Question stats



41.9% of users answered this question correctly

Session score = 7.5%

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Curriculum statement

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Question 41 of 131

Which one of the following statements regarding the power of a study is correct?

- A. Is the probability of rejecting the null hypothesis when it is false
- B. Decreases with increasing sample size
- C. Lies within 2 standard deviations of the mean
- D. Is the chance a significant p value will be reached
- E. Is equal to 1 - (the probability of a type I error)

Next question

Power = 1 - the probability of a type II error

Question stats

A	45.4%
B	8.1%
C	4.6%
D	21.5%
E	20.4%

45.4% of users answered this question correctly

Session score = 7.3%

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Curriculum statement

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)
Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

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Question 42 of 131

Which one of the following statements regarding the normal distribution is correct?

- A. Is a discrete probability distribution
- B. 99.7% of values lie within 2 standard deviations of the mean
- ✓ C. Mean = mode = median
- D. Standard deviation = mean / square root (variance)
- E. Is also referred to as the binomial distribution

Next question

The Normal distribution is a continuous probability distribution

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

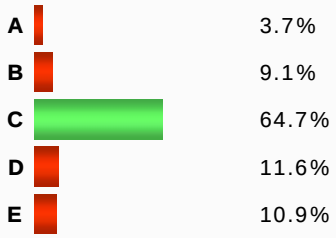
- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

Rate question:

Next question

Comment on this question

Question stats



64.7% of users answered this question correctly

Session score = 7.1%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

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Questions 43 to 45 of 131

Theme: Screening test statistics

A Specificity
B Relative risk
C Absolute risk reduction
D Sensitivity
E Negative predictive value
F Odds ratio
G Likelihood ratio for a positive test result
H Positive predictive value
I Likelihood ratio for a negative test result
J Relative risk reduction

Please select the statistical term that each phrase describes:

43. How much the odds of the disease increase when a test is positive

Specificity

The correct answer is Likelihood ratio for a positive test result

44. Proportion of patients without the condition who have a negative test result

Specificity

45. The chance that the patient has the condition if the diagnostic test is positive

Specificity

The correct answer is Positive predictive value

Next question

Question stats

Average score for registered users:

43	61.6%
44	68.1%
45	53.7%

Session score = 8.9%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a

contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	**Disease absent**
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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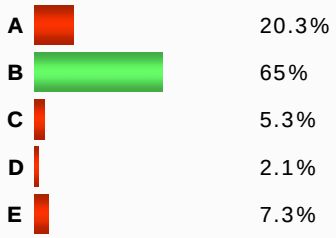
Question 46 of 131

A new blood test to screen patients for heart failure is trialled on 500 patients. The test was positive in 40 of the 50 patients shown to have heart failure by echocardiography. It was also positive in 20 patients who were shown not to have heart failure. What is the positive predictive value of the test?

- A. 0.8
- ✓ B. 0.66
- C. 0.33
- D. 0.1
- E. Cannot be calculated

Next question

Question stats



65% of users answered this question correctly

Session score = 8.7%

RCGP curriculum

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Curriculum statement

A contingency table can be constructed from the above data, as shown below:

	Heart failure	No heart failure
Test positive	40	20
Test negative	10	430

Positive predictive value = TP / (TP + FP) = 40 / (40 + 20) = 0.66

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 47 of 131

A study is performed looking at the validity of a new diagnostic test for heart failure. The study designers are concerned that not all patients may receive the gold-standard existing test. What type of bias does this describe?

- A. Attention bias
- B. Selection bias
- ✓ C. Work-up bias
- D. Co-intervention bias
- E. Instrument bias

Next question

Question stats

A	8.7%
B	35.1%
C	32.8%
D	15.3%
E	8.2%

32.8% of users answered this question correctly

Session score = 8.5%

Bias

Bias describes the situation in a trial where one outcome is systematically favoured. A number of different types of bias are recognised:

Selection bias	Error in assigning individuals to groups leading to differences which may influence outcome. Subtypes include **sampling bias** where the subjects are not representative of the population. This may be due to **volunteer bias**. An example of volunteer bias would be a study looking at the prevalence of *Chlamydia* in the student population. Students who are at risk of *Chlamydia* may be more, or less, likely to participate in the study. A similar concept is **non-responder bias**. If a survey on dietary habits was sent out in the post to random households it is likely that the people who didn't respond would have poorer diets than those who did.
Publication bias	Failure to publish results from valid studies, often as they showed a negative or uninteresting result. Important in meta-analyses where studies showing negative results may be excluded.
Work-up bias (verification bias)	Mainly seen in studies trying to validate a new diagnostic test. Refers to the gold-standard diagnostic test being done more frequently in patients who have already had a positive new test.
Expectation bias	Only a problem in non-blinded trials. Observers may subconsciously measure or report data in a way that favours the expected study outcome.
Recall bias	A particular problem in case-control studies.

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Curriculum statement

Rate question:

Next question

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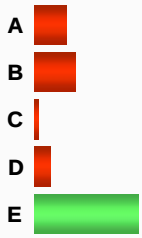
Question 48 of 131

A new antihypertensive is in phase III development. A study is designed where a margin is defined (-delta to +delta) on mean blood pressure reduction. If the confidence interval of the difference between the new drug and ramipril lies within this margin then the trial can be said to have produced a positive result. What is this an example of?

- A. Non-inferiority trial
- B. Superiority trial
- C. Placebo-controlled trial
- D. Delta-controlled trial
- ✓ E. Equivalence trial

Next question

Question stats



53.1% of users answered this question correctly

Session score = 8.3%

Study design: new drugs

When a new drug is launched there are a number of options available in terms of study design. One option is a placebo controlled trial. Whilst this may provide robust evidence it may be considered unethical if established treatments are available and it also does not provide a comparison with standard treatments.

If a drug is therefore to be compared to an existing treatment a statistician will need to decide whether the trial is intended to show superiority, equivalence or non-inferiority:

- superiority: whilst this may seem the natural aim of a trial one problem is the large sample size needed to show a significant benefit over an existing treatment
- equivalence: an equivalence margin is defined (-delta to +delta) on a specified outcome. If the confidence interval of the difference between the two drugs lies within the equivalence margin then the drugs may be assumed to have a similar effect
- non-inferiority: similar to equivalence trials, but only the lower confidence interval needs to lie within the equivalence margin (i.e. -delta). Small sample sizes are needed for these trials. Once a drug has been shown to be non-inferior large studies may be performed to show superiority

It should be remembered that drug companies may not necessarily want to show superiority over an existing product. If it can be demonstrated that their product is equivalent or even non-inferior then they may compete on price or convenience.

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Curriculum statement

External links

European Medicines Agency
Further information on trial design

Rate question:

Next question

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Question 49 of 131

A study is performed looking at the chance of stroke in high-risk patients taking a new oral antithrombotic drug compared to warfarin. The following results are obtained:

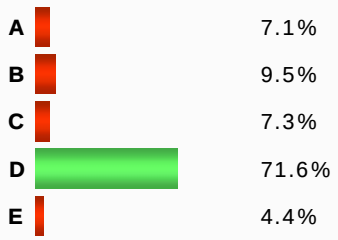
	Total number of patients	Number who had a stroke within a 3 year period
New drug	200	10
Warfarin	600	12

What is the relative risk of having a stroke within a 3 year period for patients taking the new drug compared to warfarin?

- A. 3.33
- B. 0.66
- C. 1.2
- ✓ D. 2.5
- E. Cannot calculate from above data

Next question

Question stats



71.6% of users answered this question correctly

Session score = 8.2%

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Curriculum statement

Relative risk = EER / CER

Experimental event rate, EER = 10 / 200 = 0.05

Control event rate, CER = 12 / 600 = 0.02

Therefore the relative risk = EER / CER = 0.05 / 0.02 = 2.5

Relative risk

Relative risk (RR) is the ratio of risk in the experimental group (experimental event rate, EER) to risk in the control group (control event rate, CER)

To recap

- EER = rate at which events occur in the experimental group
- CER = rate at which events occur in the control group

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Experienced significant pain relief

Paracetamol	100	60
Placebo	80	20

Experimental event rate, EER = 60 / 100 = 0.6

Control event rate, CER = 20 / 80 = 0.25

Therefore the relative risk = EER / CER = 0.6 / 0.25 = 2.4

If the risk ratio is > 1 then the rate of an event (in this case experiencing significant pain relief) is increased compared to controls. It is therefore appropriate to calculate the relative risk increase if necessary (see below).

If the risk ratio is < 1 then the rate of an event is decreased compared to controls. The relative risk reduction should therefore be calculated (see below).

Relative risk reduction (RRR) or **relative risk increase (RRI)** is calculated by dividing the absolute risk change by the control event rate

Using the above data, RRI = (EER - CER) / CER = (0.6 - 0.25) / 0.25 = 1.4 = 140%

Rate question:

Next question

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Question 50 of 131

A rapid urine screening test is developed to detect *Chlamydia*. A trial involving 200 men and women is performed comparing the new test to the existing NAAT techniques:

	***Chlamydia* present**	***Chlamydia* absent**
New test positive	20	3
New test negative	5	172

What is the negative predictive value of the new test?

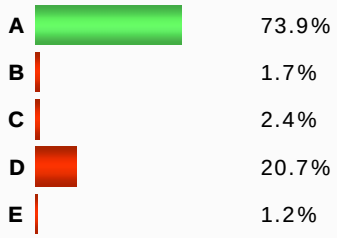
- ✓ A. 172/177
- B. 20/23
- C. 172/192
- D. 172/175
- E. 20/25

Next question

Negative predictive value = TN / (TN + FN)

= 172 / (172 + 5)

Question stats



73.9% of users answered this question correctly

Session score = 8%

RCGP curriculum

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Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	**Disease absent**
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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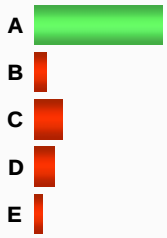
Question 51 of 131

A study measures a patients serum cholesterol before and after a new lipid-lowering therapy has been given. What type of significance test should be used to analyse the data?

- ✓ A. Student's paired t-test
- B. Student's unpaired t-test
- C. Chi-squared test
- D. Pearson's test
- E. Spearman test

Next question

Question stats



65% of users answered this question correctly

Session score = 7.8%

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

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Curriculum statement

Rate question:

Next question

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Questions 52 to 54 of 131

Theme: Key trials: diabetes mellitus

A HOPE
B Heart Protection Study
C DREAM
D DCCT
E Stop-NIDDM
F XENDOS
G IDPP
H UKPDS

For each one of the following please select the relevant trial:

Question stats

Average score for registered users:

52 23.3%
53 34.5%
54 41.2%

Session score = 7.4%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

52. Showed the benefit of tight glycaemic control in type 1 diabetics

HOPE

The correct answer is DCCT

53. Suggests that the onset of diabetes in patients with impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT) could be delayed by rosiglitazone

HOPE

The correct answer is DREAM

Rosiglitazone was withdrawn in 2010 following concerns about the cardiovascular side-effect profile.

54. Showed the benefit of tight glycaemic control in type 2 diabetics

HOPE

The correct answer is UKPDS

Next question

Key trials: diabetes mellitus

The following table summarises some of the key trials that have altered the approach to diabetes mellitus:

UKPDS	The United Kingdom Prospective Diabetes Study was a seminal trial of over 5,000 patients with type 2 diabetes mellitus. Patients were followed for an average of 10 years to establish whether control of blood glucose levels was associated with clinical benefits (reduced macrovascular and microvascular complications) and whether there was an advantage to any particular type of drug treatment. UKPDS also had a blood pressure control arm to establish whether this had an impact on complication rates. Main results • UKPDS confirmed the importance of tight glycaemic and blood pressure control in type 2 diabetics • both macrovascular and microvascular complications were reduced in patients with tight glycaemic control
DCCT	The Diabetes Control and Complications Trial involved 1,400 patients with type 1 diabetes mellitus in the US and Canada between 1983 and 1993. Main results • DCCT showed a significant reduction in microvascular complications for patients who had tight glycaemic control • there was a higher incidence of hypoglycaemia in the group who had tight glycaemic control
DREAM	The Diabetes Reduction Assessment with ramipril and rosiglitazone Medication trial looked at whether patients with impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT) could be stopped from developing type 2 diabetes by using either ramipril and rosiglitazone. The study showed that the onset of type 2 diabetes may be delayed by rosiglitazone therapy.

Rate question:

Next question

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Question 55 of 131

A study looks at the benefits of adding a new antiplatelet drug to aspirin following a myocardial infarction. The following results are obtained:

	Percentage of patients having further MI within 3 months
Aspirin	4%
Aspirin + new drug	3%

What is the number needed to treat to prevent one patient having a further myocardial infarction within 3 months?

- A. 0.75
- B. 0.33
- C. Cannot calculate without more data
- D. 1
- ✓ E. 100

Next question

NNT = 1 / (CER - EER), or 1 / Absolute Risk Reduction

NNT = 1 / (control event rate - experimental event rate)

= 1 / (0.04-0.03) = 1 / (0.01) = 100

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

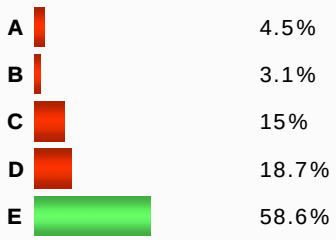
Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In

Question stats



58.6% of users answered this question correctly

Session score = 7.3%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

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Question 56 of 131

The Framingham Heart Study is an example of a:

- A. Cross-sectional survey
- ✓ B. Cohort study
- C. Case-control study
- D. Randomised controlled trial
- E. Meta-analysis

Next question

Question stats

A	6.2%
B	69%
C	7.7%
D	8.7%
E	8.4%

69% of users answered this question correctly

Session score = 7.1%

Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

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Curriculum statement

Rate question:

Next question

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Question 57 of 131

Which one of the following statements best describes a type I statistical error?

- A. The null hypothesis is rejected when it is true
- B. The null hypothesis is accepted when it is false
- C. The p value fails to reach statistical significance
- D. The alternative hypothesis is rejected when it is true
- E. A study fails to reach an appropriate power

Next question

Question stats

A	75.2%
B	19.1%
C	2.5%
D	1.6%
E	1.6%

75.2% of users answered this question correctly

Session score = 7%

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)

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Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

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Question 58 of 131

What is the correct formula to calculate the positive predictive value?

TP = true positive; FP = false positive; TN = true negative; FN = false negative

- A. Sensitivity / (1 - specificity)
- ✓ B. TP / (TP + FP)
- C. TN / (TN + FP)
- D. TN / (TN + FN)
- E. TP / (TP + FN)

Next question

Question stats

A	4.2%
B	82.7%
C	1.4%
D	1.1%
E	10.6%

82.7% of users answered this question correctly

Session score = 6.9%

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

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Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 59 of 131

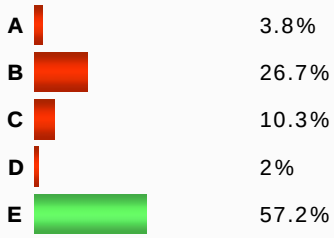
The serum potassium is measured in a 1,000 patients taking an ACE inhibitors. The mean potassium is 4.6 mmol/l with a standard deviation of 0.3 mmol/l. Which one of the following statements is correct?

- A. 95% of values lie between 4.5 and 4.75 mmol/l
- B. 95.4% of values lie between 4.3 and 4.9 mmol/l
- C. 99.7% of values lie between 4.0 and 5.2 mmol/l
- D. 68.3% of values lie between 4.5 and 4.75 mmol/l
- ✓ E. 68.3% of values lie between 4.3 and 4.9 mmol/l

Next question

We know that 68.3% of values of a normally distributed variable lie within 1 standard deviation of the mean. This means the range is 4.3 to 4.9 mmol/l.

Question stats



57.2% of users answered this question correctly

Session score = 6.8%

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Curriculum statement

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

Rate question:

Next question

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Question 60 of 131

A follow-up study is performed looking at the height of 100 adults who were given steroids during childhood. The average height of the adults is 169cm, with a standard deviation of 16cm. What is the standard error of the mean?

- A. Cannot be calculated
- B. 1.69
- C. 0.16
- ✓ D. 1.6
- E. 1.3

Next question

Standard error of the mean = standard deviation / square root (number of patients)

The standard error of the mean is calculated by the standard deviation / square root (number of patients)

= 16 / square root (100) = 16 / 10 = 1.6

Standard error of the mean

The standard error of the mean (SEM) is a measure of the spread expected for the mean of the observations - i.e. how 'accurate' the calculated sample mean is from the true population mean

Key point

- SEM = SD / square root (n)
- where SD = standard deviation and n = sample size

Therefore the SEM gets smaller as the sample size (n) increases

A confidence interval for the mean can be calculated in a similar way to that for a single observation, i.e. The 95% confidence interval:

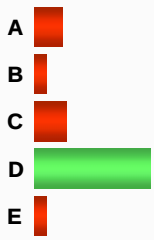
- lower limit = mean - (1.96 *SEM)
- upper limit = mean + (1.96 * SEM)

Rate question:

Next question

Comment on this question

Question stats



58.5% of users answered this question correctly

Session score = 6.7%

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Curriculum statement

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Questions 61 to 63 of 131

Theme: Data types

A Binomial
B Discrete
C Nominal
D Continuous
E Interval variable
F Ordinal

For each of the following please select the closest matching data type:

61. Data may take one of two values

Binomial

62. The NYHA classification of heart failure symptoms

Binomial

The correct answer is Ordinal

63. The height of a patient

Binomial

The correct answer is Continuous

Next question

Question stats

Average score for registered users:

61	85.9%
62	30.8%
63	57.7%

Session score = 7.9%

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Curriculum statement

Data types

Data type	Description
Nominal	Observed values can be put into set categories which have no particular order or hierarchy. You can count but not order or measure nominal data (for example birthplace)
Ordinal	Observed values can be put into set categories which themselves can be ordered (for example NYHA classification of heart failure symptoms)
Discrete	Observed values are confined to a certain values, usually a finite number

	of whole numbers (for example the number of asthma exacerbations in a year)
Continuous	Data can take any value with certain range (for example weight)
Binomial	Data may take one of two values (for example gender)
Interval	A measurement where the difference between two values is meaningful, such that equal differences between values correspond to real differences between the quantities that the scale measures (for example temperature)

Rate question:

Next question

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Question 64 of 131

A new drug which may reduce the chance of patients with chronic kidney disease developing gout is introduced. In one study of 2,000 patients 1,200 received the new drug of which 120 patients develop gout. The remaining 800 patients received a placebo of which 200 developed gout. What is the absolute risk reduction of developing gout?

- A. 0.1
- ✓ B. 15%
- C. 120
- D. 25%
- E. 6.66

Next question

Question stats

A	6%
B	70.1%
C	1.8%
D	14.5%
E	7.5%

70.1% of users answered this question correctly

Session score = 7.8%

RCGP curriculum

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Curriculum statement

Absolute risk reduction = (Control event rate) - (Experimental event rate)

Absolute risk reduction = (Experimental event rate) - (Control event rate)

Control event rate = 200 / 800 = 0.25
Experimental event rate = 120 / 1,200 = 0.1

Absolute risk reduction = 0.25 - 0.1 = 0.15 = 15% reduction

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

Comment on this question

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Question 64 of 131

A new drug which may reduce the chance of patients with chronic kidney disease developing gout is introduced. In one study of 2,000 patients 1,200 received the new drug of which 120 patients develop gout. The remaining 800 patients received a placebo of which 200 developed gout. What is the absolute risk reduction of developing gout?

- A. 0.1
- ✓ B. 15%
- C. 120
- D. 25%
- E. 6.66

Next question

Question stats

A	6%
B	70.1%
C	1.8%
D	14.5%
E	7.5%

70.1% of users answered this question correctly

Session score = 7.8%

RCGP curriculum

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Curriculum statement

Absolute risk reduction = (Control event rate) - (Experimental event rate)

Absolute risk reduction = (Experimental event rate) - (Control event rate)

Control event rate = 200 / 800 = 0.25
Experimental event rate = 120 / 1,200 = 0.1

Absolute risk reduction = 0.25 - 0.1 = 0.15 = 15% reduction

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

Comment on this question

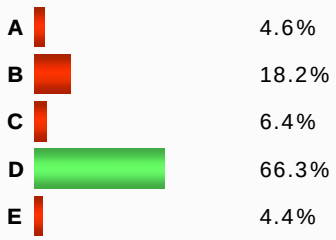
Question 65 of 131

A new test to screen for ovarian cancer in patients with a positive family history is tested on 920 patients. The test is positive in 16 of the 20 patients who are proven to have ovarian cancer. Of the remaining patients, only 10 have a positive test. What is the negative predictive value of the new test?

- A. 900/920 = 97.8%
- B. 890/900 = 98.9%
- C. 10/900 = 1.1%
- ✓ D. 890/894 = 99.6%
- E. 890/920 = 96.7%

Next question

Question stats



66.3% of users answered this question correctly

Session score = 7.7%

RCGP curriculum

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Curriculum statement

A contingency table can be constructed from the above data, as shown below:

	Ovarian cancer	No ovarian cancer
Test positive	16	10
Test negative	4	890

The negative predictive value = TN / (TN + FN) = 890 / (890 + 4) = 890/894

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 66 of 131

Which one of the following significance tests is used to analyse data which is measured and follows a normal distribution?

- A. Chi-squared test
- B. Spearman's rank correlation coefficient
- C. Wilcoxon matched-pairs
- D. Mann-Whitney test
- ✓ E. Student's t-test

Next question

Student's t-test is used to analyse parametric data. The other tests are used on non-parametric data

Question stats

A	16.3%
B	9.3%
C	1.4%
D	6.5%
E	66.6%

66.6% of users answered this question correctly

Session score = 7.6%

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

RCGP curriculum

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Curriculum statement

Rate question:

Next question

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Question 67 of 131

A new blood test is developed to screen for prostate cancer. Trials have shown it has a sensitivity for detecting clinically significant prostate cancer of 80% but a specificity of 60%. What is the likelihood ratio for a positive test result?

- A. Cannot be calculated
- ✓ B. 2
- C. 4
- D. 0.8
- E. 0.2

Next question

Question stats

A	19.1%
B	51.8%
C	6.2%
D	13.1%
E	9.7%

51.8% of users answered this question correctly

Session score = 7.5%

Likelihood ratio for a positive test result = sensitivity / (1 - specificity)

Likelihood ratio for a positive test result = sensitivity / (1 - specificity)

= 0.8 / (1 - 0.6) = 2

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 -	How much the odds of the disease increase when a test is positive

	specificity)	
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 68 of 131

Which one of the following statements regarding epidemiological measures is correct?

- A. Cross-sectional surveys can be used to estimate the prevalence of a condition in the population
- B. In chronic diseases the incidence is much greater than the prevalence
- C. Incidence = prevalence * duration of condition
- D. The prevalence is the number of new cases per population in a given time period
- E. Pre-test probability = 1 / incidence

Next question

Question stats

A	70.9%
B	3.5%
C	8.7%
D	9.3%
E	7.6%

70.9% of users answered this question correctly

Session score = 7.4%

Incidence and prevalence

These two terms are used to describe the frequency of a condition in a population.

The **incidence** is the number of new cases per population in a given time period.

For example, if condition X has caused 40 new cases over the past 12 months per 1,000 of the population the annual incidence is 0.04 or 4%.

The **prevalence** is the total number of cases per population at a particular point in time.

For example, imagine a questionnaire is sent to 2,500 adults asking them how much they weigh. If from this sample population of 500 of the adults were obese then the prevalence of obesity would be 0.2 or 20%.

Relationship

- prevalence = incidence * duration of condition
- in chronic diseases the prevalence is much greater than the incidence
- in acute diseases the prevalence and incidence are similar. For conditions such as the common cold the incidence may be greater than the prevalence

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Curriculum statement

Rate question:

Next question

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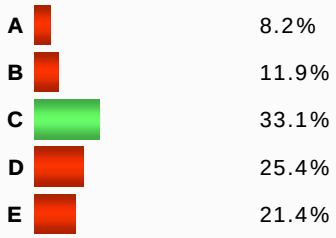
Question 69 of 131

Which one of the following statements regarding odds and odds ratio is correct?

- A. Odds ratio = 1 / attributable risk
- B. Is always between 0 and 1 (when expressed as a decimal)
- ✓ C. The odds ratio approximates to relative risk if the outcome of interest is rare
- D. Odds ratios are the most commonly reported measure in cohort studies
- E. When applied to survival analysis is termed the hazard ratio

Next question

Question stats



33.1% of users answered this question correctly

Session score = 7.2%

Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

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Curriculum statement

Rate question:

Next question

Comment on this question

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Questions 70 to 72 of 131

Theme: Screening test statistics

A 50/300
B 300/400
C 50/350
D 50/400
E 100/350
F 350/400
G 350/450
H 300/650

A new blood test is developed to screen for ovarian cancer. A study produces the following results:

	Disease present	Disease not present
New test positive	300	100
New test negative	50	350

For each of the following give the correct value:

70. Positive predictive value

50/300

The correct answer is 300/400

71. Specificity

50/300

The correct answer is 350/450

72. Negative predictive value

50/300

The correct answer is 350/400

Next question

Question stats

Average score for registered users:

70 88.8%
71 75.2%
72 75.7%

Session score = 6.9%

RCGP curriculum

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Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	**Disease absent**
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

Comment on this question

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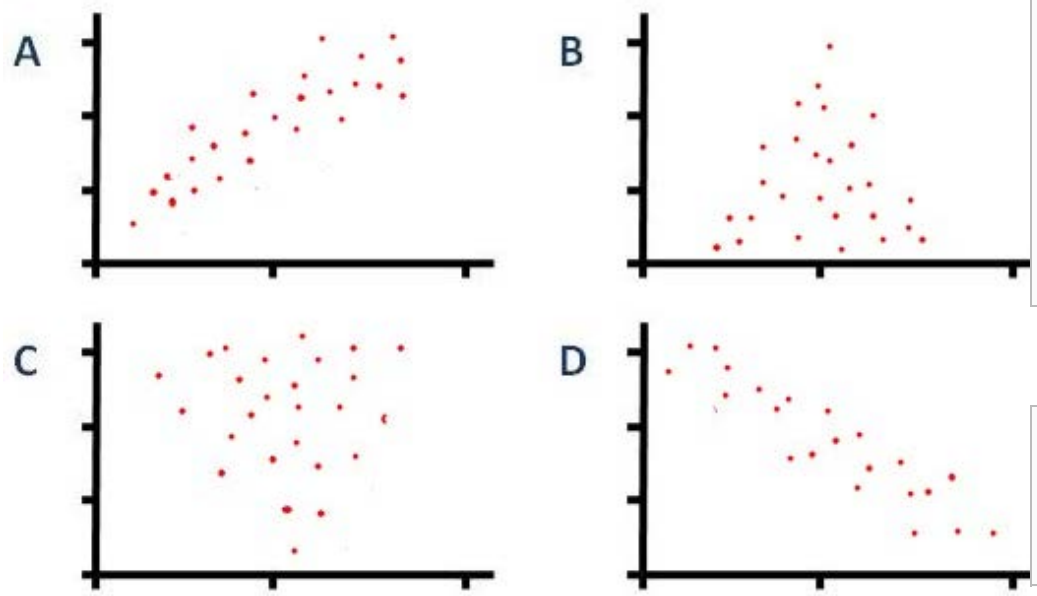
Question 73 of 131

You review four meta-analyses as part of an educational presentation you are preparing. The funnel plots below summarise the studies which are included in each meta-analysis, with the treatment effect on the x-axis and study size on the y-axis.



Question stats

A	5.2%
B	58.5%
C	27.6%
D	3.6%
E	5.2%

58.5% of users answered this question correctly

Session score = 6.8%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Which one of the funnel plots suggests an absence of publication bias?

- A. Funnel plot A
- ✓ B. Funnel plot B
- C. Funnel plot C
- D. Funnel plot D
- E. None of them

Next question

The symmetrical, funnel shape indicates an absence of publication bias.

Funnel plot

A funnel plot is primarily used to demonstrate the existence of publication bias in meta-analyses. Funnel plots are usually drawn with treatment effects on the horizontal axis and study size on the vertical axis.

Interpretation

- a symmetrical, inverted funnel shape indicates that publication bias is unlikely
- conversely, an asymmetrical funnel indicates a relationship between treatment effect and study size. This indicates either publication bias or a

systematic difference between smaller and larger studies ('small study effects')

Rate question:

Next question

Comment on this question

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Question 74 of 131

A study is performed to assess the correlation between age and systolic blood pressure. Which one of the following statements regarding the calculation of the correlation coefficient, r, is incorrect?

- A. A value of r greater than 0 implies a positive correlation between age and systolic blood pressure
- B. If r = 0 then there is no correlation between systolic blood pressure and age
- C. r may lie anywhere between -1 and 1
- ✓ D. May be used to predict systolic blood pressure for a given age
- E. Do not provide evidence of cause and effect

Next question

Linear regression is needed to predict systolic blood pressure in this scenario

Question stats

A	8%
B	11.5%
C	17.2%
D	40.5%
E	22.8%

40.5% of users answered this question correctly

Session score = 6.8%

RCGP curriculum

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Curriculum statement

Correlation and linear regression

Two measurements, or variables, may be plotted on a scatter plot. For example, age may be marked along the x axis and systolic blood pressure along the y axis

Correlation

The correlation coefficient (sometimes referred to as Pearson's product-moment coefficient) indicates how closely the points lie to a line drawn through the plotted data. It is denoted by the value r which may lie anywhere between -1 and 1.

For example

- r = 1 - strong positive correlation (e.g. systolic blood pressure always increases with age)
- r = 0 - no correlation (e.g. there is no correlation between systolic blood pressure and age)
- r = - 1 - strong negative correlation (e.g. systolic blood pressure always decreases with age)

Whilst correlation coefficients give information about how one variable may increase or decrease as another variable increases they do not give information about how much the variable will change. They also do not provide information on cause and effect

Linear regression

In contrast to the correlation coefficient, linear regression may be used to predict how much one variable changes when a second variable is changed. A regression equation may be formed, y = a + bx, where

- y = the variable being calculated
- a = the intercept value, when x = 0

- b = the slope of the line or regression coefficient. Simply put, how much y changes for a given change in x
- x = the second variable

Rate question:

Next question

Comment on this question

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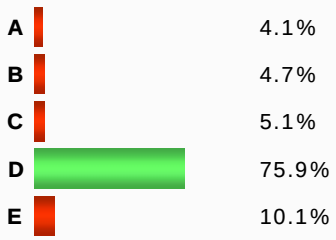
Question 75 of 131

Which one of the following statements regarding significance tests is incorrect?

- A. Parametric data is usually normally distributed
- B. Student's t-test may be paired on unpaired
- C. Pearson's product-moment coefficient is used to assess correlation between two variables
- ✓ D. Chi-squared test is used to compare parametric data
- E. Paired data refers to data obtained from a single group of patients

Next question

Question stats



75.9% of users answered this question correctly

Session score = 6.7%

Significance tests: types

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Curriculum statement

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

Comment on this question

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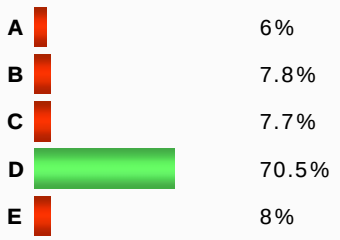
Question 76 of 131

A study looks at adding a new antiplatelet drug in addition to aspirin to patients who've had a stroke. One hundred and seventy patients are enrolled for the study with 120 receiving the new drug in addition to aspirin and the remainder receiving just aspirin. After 5 years 18 people who received the new drug had a further stroke compared to 10 people who just received aspirin. What is the number needed to treat?

- A. 8
- B. 15
- C. 1.8
- ✓ D. 20
- E. 10

Next question

Question stats



70.5% of users answered this question correctly

Session score = 6.6%

NNT = 1 / (CER - EER), or 1 / Absolute Risk Reduction

Control event rate = 10 / 50 = 0.2
Experimental event rate = 18 / 120 = 0.15

Absolute risk reduction = 0.2 - 0.15 = 0.05
Number needed to treat = 1 / 0.05 = 20

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Curriculum statement

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

Comment on this question

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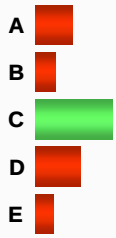
Question 77 of 131

A study is designed to see whether the degree of chest pain is linked to the troponin I value for patients admitted following a myocardial infarction. The pain is assessed using a scale of 1-10, with 10 representing the worst pain that the patient has ever experienced. Which one of the following significance tests is it most appropriate to use to investigate this link?

- A. Student's t-test
- B. Chi-squared test
- ✓ C. Spearman's rank correlation coefficient
- D. Pearson's product-moment coefficient
- E. Mann-Whitney test

Next question

Question stats



A	18.8%
B	9.5%
C	39.3%
D	23.5%
E	8.9%

39.3% of users answered this question correctly

Session score = 6.5%

This scenario looks at whether the values are correlated. As the data is non-parametric, particularly the observation based pain scale, Spearman's rank correlation coefficient should be used.

RCGP curriculum

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Curriculum statement

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

Comment on this question

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Question 78 of 131

Which one of the following statements regarding significance tests is correct?

- A. The chance of making a type I error is not affected by sample size
- B. The probability of making a type II error is termed alpha
- C. Type I errors are false negatives
- D. A p value of 0.1 or less is usually deemed significant
- E. A type III error is defined as a study which has insufficient power

Next question

Question stats

A	40.2%
B	10.2%
C	25.9%
D	15.9%
E	7.9%

40.2% of users answered this question correctly

Session score = 6.4%

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

	Study accepts H_0	Study rejects H_0
Reality H_0		Type 1 error (alpha)

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Curriculum statement

Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

Comment on this question

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Questions 79 to 81 of 131

Theme: Key trials: hypertension

A STOP-2
B LIFE
C ASCOT
D HOT
E MERIT
F ACCOMPLISH
G ALLHAT
H INSIGHT

For each one of the following please select the relevant trial:

Question stats

Average score for registered users:

79	35.9%
80	31.7%
81	40.3%

Session score = 7.4%

RCGP curriculum

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Curriculum statement

79. Demonstrated that lowering blood pressure was the most important factor in the elderly population, rather than the choice of medication

STOP-2

80. Demonstrated the efficacy of thiazide diuretics in preventing cardiovascular disease. The trial also included a large number of non-white patients.

STOP-2

The correct answer is ALLHAT

81. Resulted in a major shift away from the use of beta-blockers in the management of hypertension

STOP-2

The correct answer is ASCOT

Next question

Key trials: hypertension

The following table summarises some of the key trials that have altered the approach to hypertension:

STOP-2	The 1999 Swedish Trial in Old Patients with Hypertension-2 study looked at whether older drugs (beta-blockers or thiazides) or newer drugs (ACE inhibitors or calcium channel blockers) were better at preventing fatal cardiovascular disease. Main results • old and new antihypertensive drugs were similar in prevention of cardiovascular mortality or major events • decrease in blood pressure was the most important factor in the prevention of cardiovascular events in this age group • supports the NICE approach to using older agents first-line in the elderly population
ALLHAT	The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial was a large randomised controlled trial that was started in 1994 and reported in 2002. ALLHAT compared amlodipine, chlorthalidone (a thiazide), lisinopril and doxazosin. Over 40,000 patients aged 55 years or older who had hypertension with one other risk factor (for example diabetes) were included in the trial. ALLHAT is seen as a landmark trial due to the large size and inclusion of minority groups such as people of Afro-Caribbean descent. Main results • chlorthalidone outperformed lisinopril in preventing cardiovascular disease, a surprising finding which has been debated since (particularly in relation to the large number of black patients in the trial (ACE inhibitors are known to be less effective in this group) • the doxazosin arm was stopped prematurely due to a higher incidence of heart failure • 60% of patients reached the target blood pressure of 140/90 mmHg (it was generally thought prior to the trial that blood pressure targets were more difficult to achieve)
ASCOT	The 2003 Anglo-Scandinavian Cardiac Outcomes Trial – Blood Pressure Lowering Arm was a double-blinded, randomised controlled trial of around 20,000 patients with hypertension and other risk factors. Patients were randomised to either atenolol (with the addition of bendroflumethiazide if needed) or amlodipine (with the addition perindopril if needed). The primary outcome was non-fatal myocardial infarction (MI) and fatal ischaemic heart disease (IHD). Main results • the study was stopped prematurely because of a higher death rate in the atenolol assigned group • the group receiving amlodipine-based regimes had a non-significant 10% reduction in primary outcomes (non-fatal MI plus fatal IHD) and significant reductions in nearly all secondary cardiovascular endpoints and new-onset diabetes • the trial resulted in a major shift away from the use of beta-blockers in the management of hypertension

Rate question: Next question

Comment on this question

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Question 82 of 131

A study is performed to find the normal reference range for IgE levels in adults. Assuming IgE levels follow a normal distribution, what percentage of adults will have an IgE level higher than 2 standard deviations from the mean?

- A. 1.25%
- ✓ B. 2.3%
- C. 1.96%
- D. 5%
- E. 0.5%

Next question

For normally distributed data 95.4% of values lie within 2 standard deviations of the mean, leaving 4.6% outside this range. Therefore 2.3% of values will be higher and 2.3% will be lower than 2 standard deviations from the mean. This figure is sometimes approximated to 2.5%

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

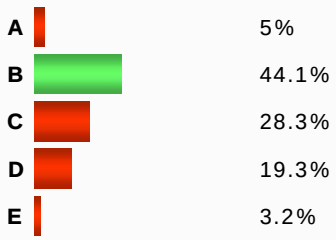
- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

Rate question:

Next question

Comment on this question

Question stats



44.1% of users answered this question correctly

Session score = 7.3%

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Curriculum statement

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Question 83 of 131

Which one of the following best describes the characteristics of a negatively skewed distribution?

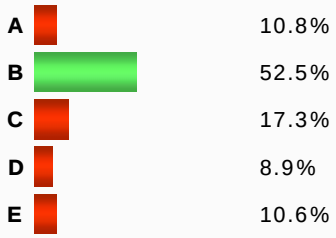
- A. Median < mode < mean
- ✓ B. Mean < median < mode
- C. Mode < mean < median
- D. Median < mean < mode
- E. Mean < mode < median

Next question

Skewed distributions

- alphabetical order: mean - median - mode
- '>' for positive, '<' for negative

Question stats



52.5% of users answered this question correctly

Session score = 7.2%

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Curriculum statement

Skewed distributions

Normal distributions: mean = median = mode

Positively skewed distribution: mean > median > mode

Negatively skewed distribution mean < median < mode

To remember the above note how they are in alphabetical order, think positive going forward with '>', whilst negative going backwards '<'

Rate question:

Next question

Comment on this question

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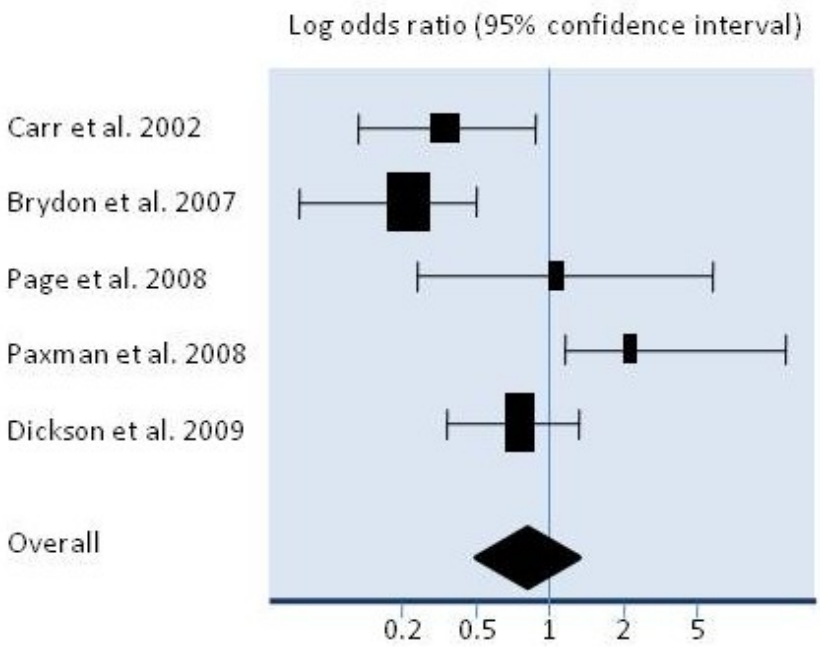
Question 84 of 131

You are reviewing the results of a meta-analysis for an educational presentation. It looks at the association between a new oral contraceptive pill with cervical cancer. Five studies reported the odds ratio of developing cervical cancer on the new pill compared to a second generation combined oral contraceptive. The results are displayed below:



Which one of the trials shows a non-significant reduction in the incidence of cervical cancer?

- ✓ A. Dickson et al
- B. None of them
- C. Carr et al + Brydon et al
- D. Paxman et al
- E. Page et al

Next question

The 95% confidence interval of the Dickson study crosses the line indicating a non-significant result. Page et al shows a non-significant increase in the incidence of cervical cancer.

Forest plots

Forest plots are usually found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials.

The name of the trials is listed down the left hand side, usually in chronological

Question stats

A	53%
B	2.3%
C	9.8%
D	16.8%
E	18.1%

53% of users answered this question correctly

Session score = 7.1%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

order. On the right hand side the results of the studies are shown as squares centred on the point estimate of the result of each trial. The size of the square is proportional to the weight of the study in the meta-analysis. The line running through the square shows the confidence interval, usually at 95%. Beneath the individual trials is the summary result (i.e. The result of the meta-analysis) represented by a diamond.

Rate question:

Next question

Comment on this question

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Question 85 of 131

Which one of the following is equivalent to the pre-test probability?

- A. Post test odds / (1 + post-test odds)
- B. Pre-test odds x likelihood ratio
- ✓ C. The prevalence of a condition
- D. The incidence of a condition
- E. Post-test odds / likelihood ratio

Next question

The prevalence is the proportion of a population that have the condition at a point in time whilst the incidence is the rate at which new cases occur in a population during a specified time period.

Pre- and post- test odds and probability

Pre-test probability

The proportion of people with the target disorder in the population at risk at a specific time (point prevalence) or time interval (period prevalence)

For example, the prevalence of rheumatoid arthritis in the UK is 1%

Post-test probability

The proportion of patients with that particular test result who have the target disorder

Post-test probability = post test odds / (1 + post-test odds)

Pre-test odds

The odds that the patient has the target disorder before the test is carried out

Pre-test odds = pre-test probability / (1 - pre-test probability)

Post-test odds

The odds that the patient has the target disorder after the test is carried out

Post-test odds = pre-test odds x likelihood ratio

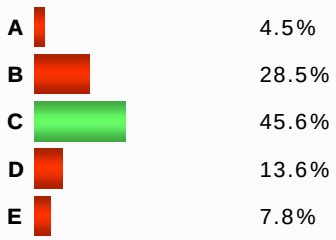
where the likelihood ratio for a positive test result = sensitivity / (1 - specificity)

Rate question:

Next question

Comment on this question

Question stats



45.6% of users answered this question correctly

Session score = 7.1%

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3.5 - Evidence-based Practice

Curriculum statement

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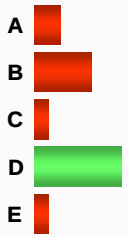
Question 86 of 131

A new anti-epileptic drug is trialled for children with absence seizures. There are 250 children in the control group and 150 children assigned to take the new drug. After 4 months 100 children in the control group had had a seizure compared to 15 children in the group taking the new medication. What is the relative risk reduction?

- A. 4
- B. 30%
- C. 3.33
- ✓ D. 75%
- E. 40%

Next question

Question stats



44.3% of users answered this question correctly

Session score = 7%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Relative risk reduction = (EER - CER) / CER

Experimental event rate, EER = 15 / 150 = 0.1

Control event rate, CER = 100 / 250 = 0.4

Relative risk reduction = (EER - CER) / CER = (0.1 - 0.4) / 0.4 = -0.75 or a 75% reduction

Relative risk

Relative risk (RR) is the ratio of risk in the experimental group (experimental event rate, EER) to risk in the control group (control event rate, CER)

To recap

- EER = rate at which events occur in the experimental group
- CER = rate at which events occur in the control group

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Experienced significant pain relief
Paracetamol	100	60
Placebo	80	20

Experimental event rate, EER = 60 / 100 = 0.6

Control event rate, CER = 20 / 80 = 0.25

Therefore the relative risk = EER / CER = 0.6 / 0.25 = 2.4

If the risk ratio is > 1 then the rate of an event (in this case experiencing significant pain relief) is increased compared to controls. It is therefore appropriate to calculate the relative risk increase if necessary (see below).

If the risk ratio is < 1 then the rate of an event is decreased compared to controls. The relative risk reduction should therefore be calculated (see below).

Relative risk reduction (RRR) or **relative risk increase (RRI)** is calculated by dividing the absolute risk change by the control event rate

Using the above data, RRI = (EER - CER) / CER = (0.6 - 0.25) / 0.25 = 1.4 = 140%

Rate question:

Next question

Comment on this question

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Question 87 of 131

You are asked to design a study to assess whether living near electricity pylons is a risk factor for childhood leukaemia. What is the most appropriate type of study design?

- A. Cross-over trial
- B. Cohort study
- C. Cross-sectional survey
- ✓ D. Case-control study
- E. Randomised controlled trial

Next question

As the outcome (childhood leukaemia) is relatively rare a cohort study would take an extremely long time to provide significant results

Question stats

A	0.8%
B	35.5%
C	8%
D	54.4%
E	1.3%

54.4% of users answered this question correctly

Session score = 6.9%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

Comment on this question

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Questions 88 to 90 of 131

Theme: Graphical representations of statistical data

A Forest plot
B Funnel plot
C Box plot
D Histogram
E Box-and-whisker plot
F Bar chart
G Stem plot
H X-Y variance plot
I Quartile plot
J Scatter plot

Please match each one of the following descriptions to the appropriate type of graph:

88. Graphical representation using Cartesian coordinates to display values for two variables for a set of data

Forest plot

The correct answer is Scatter plot

89. Graphical representation of the sample minimum, lower quartile, median, upper quartile and sample maximum

Forest plot

The correct answer is Box-and-whisker plot

90. Found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials

Forest plot

Next question

Question stats

Average score for registered users:

88	41.9%
89	47%
90	78.1%

Session score = 7.8%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Graphical representations of statistical data

The table below gives a brief summary of the main types of graphs used to represent statistical data.

Box-and-whisker plot	Graphical representation of the sample minimum, lower quartile, median, upper quartile and sample maximum
Funnel plot	Used to demonstrate the existence of publication bias in meta-analyses
Histogram	A graphical display of continuous data where the values have been categorised into a number of categories
Forest plot	Forest plots are usually found in meta-analyses and provide a graphical representation of the strength of evidence of the constituent trials
Scatter plot	Graphical representation using Cartesian coordinates to display values for two variables for a set of data
Kaplan-Meier survival plot	A plot of the Kaplan-Meier estimate of the survival function showing decreasing survival with time

Rate question:

Next question

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Question 91 of 131

A randomised controlled trial is performed to look at a new drug to prevent hip fractures in postmenopausal women. Group A consists of 1,000 women who take the new drug whilst group B contains 1,400 women taking a placebo. The hip fracture rate in group A is 2% and in group B is 4%. What is the number needed to treat to prevent one hip fracture?

- A. 10
- ✓ B. 50
- C. 6
- D. 12
- E. 2

Next question

NNT = 1 / (CER - EER), or 1 / Absolute Risk Reduction

They key to answering this question is to ignore irrelevant data such as the number of patients in each group.

Control event rate = 4% = 0.04
Experimental event rate = 2% = 0.02

Absolute risk reduction = 0.04 - 0.02 = 0.02
Number needed to treat = 1 / 0.02 = 50

Question stats

A	2.6%
B	77.1%
C	3.7%
D	4.5%
E	12.1%

77.1% of users answered this question correctly

Session score = 7.7%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

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Question 92 of 131

A 31-year-old woman is diagnosed with familial hypercholesterolaemia. You discuss the possibility of screening her relatives. The patient reports that her father has a normal cholesterol level. What is the chance her brother will also be affected?

- A. 50% ✓
- B. 66%
- C. 25%
- D. 100%
- E. 0%

Next question

As familial hypercholesterolaemia is autosomal dominant there is a 50% chance her brother will be affected.

Familial hypercholesterolaemia

Familial hypercholesterolaemia (FH) is an autosomal dominant condition that is thought to affect around 1 in 500 people. It results in high levels of LDL-cholesterol which, if untreated, may cause early cardiovascular disease (CVD). FH is caused by mutations in the gene which encodes the LDL-receptor protein.

Clinical diagnosis is now based on the **Simon Broome criteria**:

- in adults total cholesterol (TC) > 7.5 mmol/l and LDL-C > 4.9 mmol/l or children TC > 6.7 mmol/l and LDL-C > 4.0 mmol/l, plus:
- for definite FH: tendon xanthoma in patients or 1st or 2nd degree relatives or DNA-based evidence of FH
- for possible FH: family history of myocardial infarction below age 50 years in 2nd degree relative, below age 60 in 1st degree relative, or a family history of raised cholesterol levels

Management

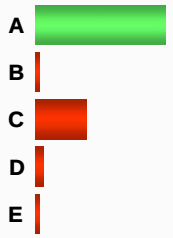
- the use of CVD risk estimation using standard tables is not appropriate in FH as they do not accurately reflect the risk of CVD
- referral to a specialist lipid clinic is usually required
- the maximum dose of potent statins are usually required
- first-degree relatives have a 50% chance of having the disorder and should therefore be offered screening
- statins should be discontinued in women 3 months before conception due to the risk of congenital defects

Rate question:

Next question

Comment on this question

Question stats



66.1% of users answered this question correctly

Session score = 7.6%

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3.5 - Evidence-based Practice

Curriculum statement

External links

NICE
2008 Familial hypercholesterolaemia guidelines

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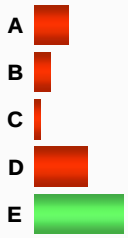
Question 93 of 131

When establishing a screening programme, which one of the following is not a key criteria as defined by Wilson and Junger?

- A. There should be a recognised latent or early symptomatic stage
- B. The condition should be an important public health problem
- C. The test or examination should be acceptable to the population
- D. There should be agreed policy on whom to treat
- ✓ E. The condition should be potentially curable

Next question

Question stats



44.7% of users answered this question correctly

Session score = 7.5%

Screening: Wilson and Junger criteria

1. The condition should be an important public health problem

2. There should be an acceptable treatment for patients with recognised disease

3. Facilities for diagnosis and treatment should be available

4. There should be a recognised latent or early symptomatic stage

5. The natural history of the condition, including its development from latent to declared disease should be adequately understood

6. There should be a suitable test or examination

7. The test or examination should be acceptable to the population

8. There should be agreed policy on whom to treat

9. The cost of case-finding (including diagnosis and subsequent treatment of patients) should be economically balanced in relation to the possible expenditure as a whole

10. Case-finding should be a continuous process and not a 'once and for all' project

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Curriculum statement

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Next question

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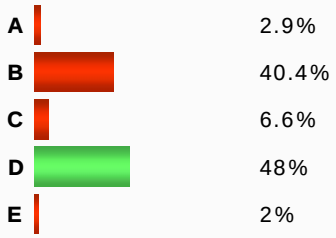
Question 94 of 131

A small study is designed to look at the link between drinking alcohol and liver cirrhosis. One hundred patients with liver cirrhosis were questioned and it was found that 80 of them drank excessive alcohol. As a control, one hundred patients without liver cirrhosis were questioned and only 20 of these patients drank excessively. What is the odds ratio of developing liver cirrhosis for people who drink excessively compared to those who do not?

- A. 2
- B. 4
- C. 0.25
- ✓ D. 16
- E. 3

Next question

Question stats



48% of users answered this question correctly

Session score = 7.4%

Odds - remember a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome

NOT a ratio of the number of people who incur a particular outcome to the total number of people

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

The odds of a patient with liver cirrhosis having a history of excessive drinking is 80/20 = 4.

The odds of a patient without liver cirrhosis having a history of excessive drinking is 20/80 = 0.25.

Therefore the odds ratio = 4 / 0.25 = 16

Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

Rate question:

Next question

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Question 95 of 131

A study is designed to compare the calcium levels of males and females who developed inflammatory bowel disease in childhood. Which one of the following statistical tests is it most appropriate to use?

- A. Pearson's test
- B. Mann-Whitney test
- C. Chi-squared test
- ✓ D. Student's unpaired t-test
- E. Student's paired t-test

Next question

As the data is parametric and compares two independent sample from the same population an unpaired t-test is the most appropriate test to use

Question stats

A	10.2%
B	9.1%
C	10.3%
D	41%
E	29.5%

41% of users answered this question correctly

Session score = 7.4%

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

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Rate question:

Next question

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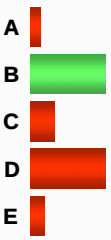
Question 96 of 131

A new screening test is developed for colorectal cancer. It is a blood test which detects a protein; the higher the level of the protein, the more likely a patient is to have colorectal cancer. If the cut-off for a positive test is increased, which one of the following will also be increased?

- A. The p value
- ✓ B. Specificity
- C. Likelihood ratio for a negative test result
- D. Sensitivity
- E. Negative predictive value

Next question

Question stats



37.7% of users answered this question correctly

Session score = 7.3%

Increasing the cut-off of a positive test result will decrease the number of false positives and hence increase the specificity

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Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) /	How much the odds of the disease decrease when a test is negative

	specificity	

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Questions 97 to 99 of 131

Theme: Screening test statistics

A TN / (TN + FN)
B TP / (TP + FN)
C Sensitivity / (1 - specificity)
D TP / (TP + FP)
E TN / (TN + FP)
F (1 - sensitivity) / specificity

For each one of the following statistical terms listed below select the correct equation

TP = true positive; FP = false positive; TN = true negative; FN = false negative

97. Likelihood ratio for a positive test result

TN / (TN + FN)

The correct answer is Sensitivity / (1 - specificity)

98. Negative predictive value

TN / (TN + FN)

99. Likelihood ratio for a negative test result

TN / (TN + FN)

The correct answer is (1 - sensitivity) / specificity

Next question

Question stats

Average score for registered users:

97 81.9%
98 86.4%
99 81.6%

Session score = 8.1%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
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Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

Comment on this question

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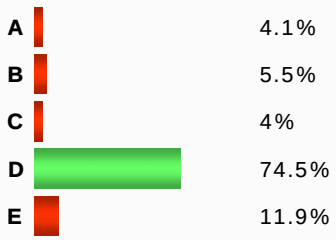
Question 100 of 131

A study is designed to assess a new proton pump inhibitor (PPI) in elderly patients who are taking aspirin. The new PPI is given to 120 patients whilst a control group of 240 is given the standard PPI. Over a five year period 24 of the group receiving the new PPI had an upper GI bleed compared to 60 who received the standard PPI. What is the absolute risk reduction?

- A. 15%
- B. 10%
- C. 12
- ✓ D. 5%
- E. 20

Next question

Question stats



74.5% of users answered this question correctly

Session score = 8%

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Absolute risk reduction = (Experimental event rate) - (Control event rate)

Control event rate = 60 / 240 = 0.25
Experimental event rate = 24 / 120 = 0.2

Absolute risk reduction = 0.25 - 0.2 = 0.05 = 5% reduction

Numbers needed to treat and absolute risk reduction

Numbers needed to treat (NNT) is a measure that indicates how many patients would require an intervention to reduce the expected number of outcomes by one

It is calculated by 1/(Absolute risk reduction) and is rounded to the next highest whole number

Experimental event rate (EER) = (Number who had particular outcome with the intervention) / (Total number who had the intervention)

Control event rate (CER) = (Number who had particular outcome with the control/ (Total number who had the control)

Absolute risk reduction = CER-EER or EER-CER?

The absolute risk reduction (ARR) may be calculated by finding the absolute difference between the control event rate (CER) and the experimental event rate (EER). You will often either version of the above listed in different sources. In some ways in doesn't matter which you use as you will end up with the same answer but from a technical point of view:

- if the outcome of the study is undesirable then ARR = CER - EER
- if the outcome of the study is desirable then ARR* = EER - CER

*this may more accurately be termed absolute benefit increase, rather than absolute risk reduction

Rate question:

Next question

Comment on this question

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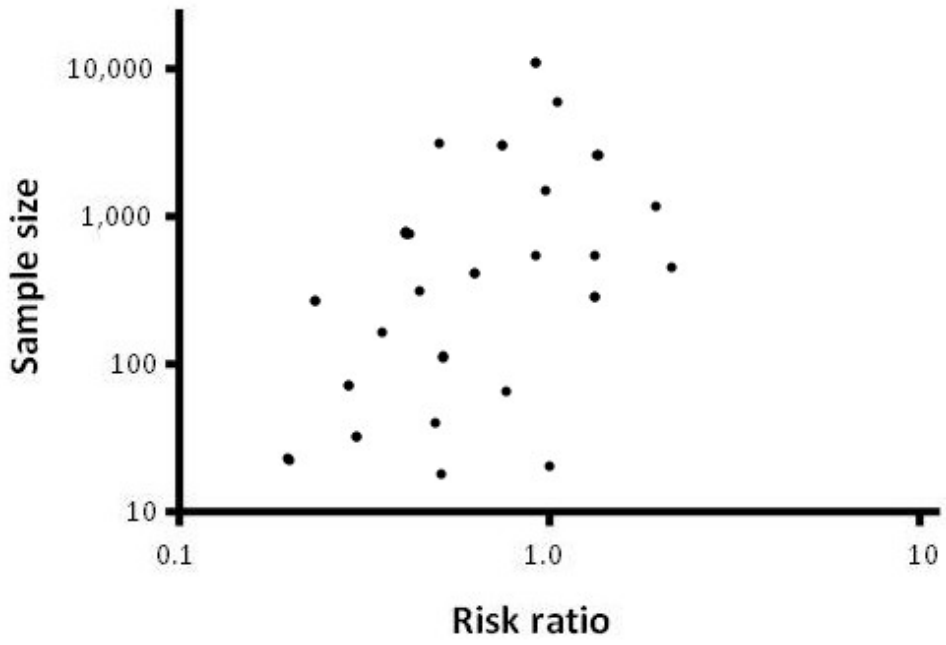
Question 101 of 131

A meta-analysis is performed looking at trials that investigate whether taking low-dose aspirin reduces the incidence of breast cancer. The results of the trials are summarised below:



What is the most appropriate interpretation of this diagram?

- A. There is no publication bias
- B. There is publication bias by larger studies which fail to find a protective effect from taking aspirin
- C. There is publication bias by larger studies which demonstrate a protective effect from taking aspirin
- ✓ D. There is publication bias by smaller studies which fail to find a protective effect from taking aspirin
- E. There is publication bias by smaller studies which demonstrate a protective effect from taking aspirin

Next question

This funnel plot clear shows a gap in the bottom right hand aspect of the diagram. This suggests a publication bias by studies which do not report a protective effect from taking aspirin, i.e. Small studies that didn't find a benefit with aspirin did not publish their results.

Funnel plot

A funnel plot is primarily used to demonstrate the existence of publication bias in meta-analyses. Funnel plots are usually drawn with treatment effects on the

Question stats

A	11.7%
B	8%
C	8.1%
D	42.6%
E	29.7%

42.6% of users answered this question correctly

Session score = 7.9%

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horizontal axis and study size on the vertical axis.

Interpretation

- a symmetrical, inverted funnel shape indicates that publication bias is unlikely
- conversely, an asymmetrical funnel indicates a relationship between treatment effect and study size. This indicates either publication bias or a systematic difference between smaller and larger studies ('small study effects')

Rate question:

Next question

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Question 102 of 131

A study is proposed to ascertain whether childhood obesity increases the risk of cancer in later life. What is the most appropriate form of study design?

- A. Cohort study
- B. Case-control study
- C. Cross-over trial
- D. Randomised controlled trial
- E. Cross-sectional survey

Next question

A cohort study would provide more robust evidence than a case-control study.

Question stats

60.9% of users answered this question correctly

Session score = 7.8%

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Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

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Question 103 of 131

What level of evidence does a randomised control trial offer?

- A. Ia
- ✓ B. Ib
- C. IIa
- D. IIb
- E. IV

Next question

Question stats

A	21.1%
B	42.3%
C	15.9%
D	8.5%
E	12.3%

42.3% of users answered this question correctly

Session score = 7.8%

Study design: evidence and recommendations

Levels of evidence

- Ia - evidence from meta-analysis of randomised controlled trials
- Ib - evidence from at least one randomised controlled trial
- IIa - evidence from at least one well designed controlled trial which is not randomised
- IIb - evidence from at least one well designed experimental trial
- III - evidence from case, correlation and comparative studies
- IV - evidence from a panel of experts

Grading of recommendation

- Grade A - based on evidence from at least one randomised controlled trial (i.e. Ia or Ib)
- Grade B - based on evidence from non-randomised controlled trials (i.e. IIa, IIb or III)
- Grade C - based on evidence from a panel of experts (i.e. IV)

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Rate question:

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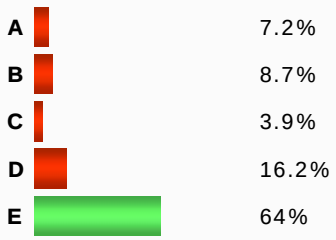
Question 104 of 131

A new study is proposed to look at the effectiveness of a new blood pressure medication. The study design group decide to perform a double-blinded randomised controlled trial. What type of bias should be avoided by ensuring the patient and doctor are blinded?

- A. Recall bias
- B. Verification bias
- C. Non-responder bias
- D. Confounding bias
- ✓ E. Expectation bias

Next question

Question stats



64% of users answered this question correctly

Session score = 7.7%

Bias

Bias describes the situation in a trial where one outcome is systematically favoured. A number of different types of bias are recognised:

Selection bias	Error in assigning individuals to groups leading to differences which may influence outcome. Subtypes include **sampling bias** where the subjects are not representative of the population. This may be due to **volunteer bias**. An example of volunteer bias would be a study looking at the prevalence of *Chlamydia* in the student population. Students who are at risk of *Chlamydia* may be more, or less, likely to participate in the study. A similar concept is **non-responder bias**. If a survey on dietary habits was sent out in the post to random households it is likely that the people who didn't respond would have poorer diets than those who did.
Publication bias	Failure to publish results from valid studies, often as they showed a negative or uninteresting result. Important in meta-analyses where studies showing negative results may be excluded.
Work-up bias (verification bias)	Mainly seen in studies trying to validate a new diagnostic test. Refers to the gold-standard diagnostic test being done more frequently in patients who have already had a positive new test.
Expectation bias	Only a problem in non-blinded trials. Observers may subconsciously measure or report data in a way that favours the expected study outcome.
Recall bias	A particular problem in case-control studies.

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Curriculum statement

Rate question:

Next question

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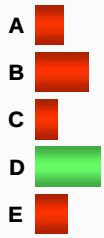
Question 105 of 131

A study is performed comparing two chemotherapy regimes for patients with small cell lung cancer. The end point of the study is survival time. Which one of the following types statistical measures is it most appropriate to compare survival time with?

- A. Odds ratio
- B. Pearson's product-moment coefficient
- C. Relative risk
- ✓ D. Hazard ratio
- E. Absolute risk reduction

Next question

Question stats



32.7% of users answered this question correctly

Session score = 7.6%

Hazard ratio

The hazard ratio (HR) is similar to relative risk but is used when risk is not constant to time. It is typically used when analysing survival over time

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Rate question:

Next question

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Questions 106 to 108 of 131

Theme: Significance tests: types

A Student's t-test - paired
B Mann-Whitney test
C Chi-squared test
D Pearson's product-moment coefficient
E Student's t-test - unpaired
F Wilcoxon matched-pairs
G Spearman's rank correlation coefficient
H Kendall tau rank correlation coefficient

For each one of the following scenarios select the most appropriate significance test:

106. Compare percentages

Student's t-test - paired

The correct answer is Chi-squared test

107. Compares two sets of non-parametric observations on a single sample

Student's t-test - paired

The correct answer is Wilcoxon matched-pairs

108. Assess degree of correlation between normally distributed data

Student's t-test - paired

The correct answer is Pearson's product-moment coefficient

Next question

Question stats

Average score for registered users:

106	75.5%
107	42.9%
108	64.2%

Session score = 7.4%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

Comment on this question

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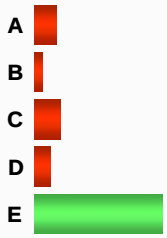
Question 109 of 131

What is the main advantage of non-inferiority trials when testing a new drug?

- A. Prevents ethical dilemmas
- B. Robust results are produced
- C. Useful for conditions where there is no proven drug treatment
- D. Useful for conditions where there is a high placebo response rate
- ✓ E. Small sample size is required

Next question

Question stats



64.6% of users answered this question correctly

Session score = 7.3%

Study design: new drugs

When a new drug is launched there are a number of options available in terms of study design. One option is a placebo controlled trial. Whilst this may provide robust evidence it may be considered unethical if established treatments are available and it also does not provide a comparison with standard treatments.

If a drug is therefore to be compared to an existing treatment a statistician will need to decide whether the trial is intended to show superiority, equivalence or non-inferiority:

- superiority: whilst this may seem the natural aim of a trial one problem is the large sample size needed to show a significant benefit over an existing treatment
- equivalence: an equivalence margin is defined (-delta to +delta) on a specified outcome. If the confidence interval of the difference between the two drugs lies within the equivalence margin then the drugs may be assumed to have a similar effect
- non-inferiority: similar to equivalence trials, but only the lower confidence interval needs to lie within the equivalence margin (i.e. -delta). Small sample sizes are needed for these trials. Once a drug has been shown to be non-inferior large studies may be performed to show superiority

It should be remembered that drug companies may not necessarily want to show superiority over an existing product. If it can be demonstrated that their product is equivalent or even non-inferior then they may compete on price or convenience.

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3.5 - Evidence-based Practice

Curriculum statement

External links

European Medicines Agency
Further information on trial design

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Question 110 of 131

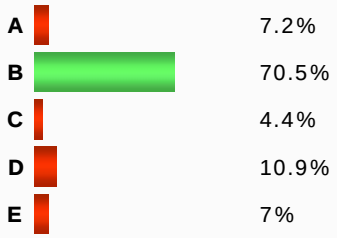
Which one of the following would invalidate the use of the Student's t-test when performing a significance test?

- A. Using it with unpaired data
- ✓ B. Using it with data that is not normally distributed
- C. Using it with data that has a small sample size
- D. Using it to test whether the slope of a regression line differs significantly from 0
- E. Using it to test a null hypothesis

Next question

Data must be parametric, i.e. follows a normal distribution

Question stats



70.5% of users answered this question correctly

Session score = 7.3%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

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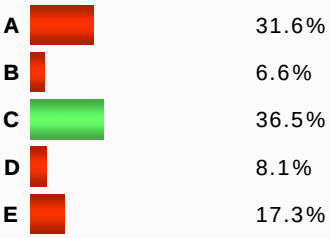
Question 111 of 131

Which one of the following statements regarding the use of the p-value in statistical hypothesis testing is correct?

- A. The p-value is the probability that the null hypothesis is true
- B. 1 - (p-value) is the probability of the alternative hypothesis being true
- ✓ C. The null hypothesis is rejected if the p-value is smaller than or equal to the significance level
- D. The p-value is the probability that a replicating experiment would not yield the same conclusion
- E. The p-value is equal to the probability of making a type II error

Next question

Question stats



36.5% of users answered this question correctly

Session score = 7.2%

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

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3.5 - Evidence-based Practice

Curriculum statement

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)
Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

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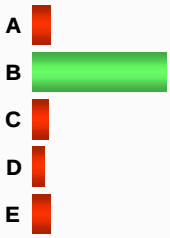
Question 112 of 131

A new blood test which can show signs of myocardial damage within one hour of the onset of chest pain is developed. In a trial of 100 patients presenting with chest pain, 40 of the patients are later proven to have had myocardial ischaemia by conventional troponin tests. Of these patients the new test was positive in 20 cases. The new test was also positive in 20 of the remaining 60 patients later shown to have a negative troponin. What is the negative predictive value of the new test for myocardial ischaemia?

- A. 0.5
- ✓ B. 0.66
- C. 0.8
- D. Cannot calculate
- E. 0.33

Next question

Question stats



68.5% of users answered this question correctly

Session score = 7.1%

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3.5 - Evidence-based Practice

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The new test was negative in 20 of the patients later shown to have myocardial ischaemia (false negative) and negative in 40 patients confirmed not to have myocardial ischaemia (true negative)

Negative predictive value = TN / (TN + FN)

= 40 / (40 + 20) = 0.66

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive

Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 113 of 131

A study is designed to assess the efficacy of a new anti-hypertensive medication. Two groups of patients are randomly assigned, one to take the established drug for 3 months whilst the other takes the new drug for 3 months. Blood pressure is measured before and after the intervention. There is then a period off medication for 1 month. After this period has elapsed the medication that the groups receive is swapped around and again blood pressure is measured before and 3 months later. The difference in blood pressure after the respective medications is calculated for each patient. Which one of the following significance tests is it most appropriate to apply?

- A. Student's unpaired t-test
- ✓ B. Student's paired t-test
- C. Pearson's test
- D. Mann-Whitney test
- E. Chi-squared test

Next question

This describes a crossover study. As we are comparing parametric data from the same patients (they swapped medication halfway through the study) the Student's paired t-test should be used.

Significance tests: types

The type of significance test used depends on whether the data is parametric (something which can be measured, usually normally distributed) or non-parametric

Parametric tests

- Student's t-test - paired or unpaired
- Pearson's product-moment coefficient - correlation

Non-parametric tests

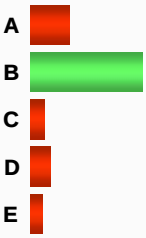
- Mann-Whitney - unpaired data
- Wilcoxon matched-pairs - compares two sets of observations on a single sample
- chi-squared test - used to compare proportions or percentages
- Spearman, Kendall rank - correlation

Paired data refers to data obtained from a single group of patients, e.g. Measurement before and after an intervention. Unpaired data comes from two different groups of patients, e.g. Comparing response to different interventions in two groups

Rate question:

Next question

Question stats



56.7% of users answered this question correctly

Session score = 7.1%

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3.5 - Evidence-based Practice

Curriculum statement

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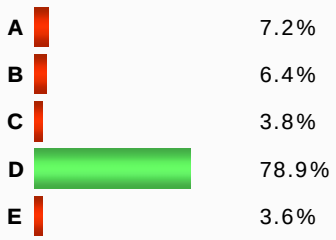
Question 114 of 131

In a normal distribution what percentage of values lie within 3 standard deviations of the mean?

- A. 68.3%
- B. 98.3%
- C. 95.4%
- ✓ D. 99.7%
- E. 97.2%

Next question

Question stats



78.9% of users answered this question correctly

Session score = 7%

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

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Questions 115 to 117 of 131

Theme: Data types

A Binomial
B Discrete
C Nominal
D Ratio variable
E Interval variable
F Ordinal

For each of the following please select the closest matching data type:

115. Observed values are confined to a certain values, usually a finite number of whole numbers

Binomial

The correct answer is Discrete

116. A measurement where the difference between two values is meaningful

Binomial

The correct answer is Interval variable

117. Hair colour

Binomial

The correct answer is Nominal

Next question

Question stats

Average score for registered users:

115	49%
116	48.4%
117	43.2%

Session score = 6.8%

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Data types

Data type	Description
Nominal	Observed values can be put into set categories which have no particular order or hierarchy. You can count but not order or measure nominal data (for example birthplace)
Ordinal	Observed values can be put into set categories which themselves can be ordered (for example NYHA classification of heart failure symptoms)

Discrete	Observed values are confined to a certain values, usually a finite number of whole numbers (for example the number of asthma exacerbations in a year)
Continuous	Data can take any value with certain range (for example weight)
Binomial	Data may take one of two values (for example gender)
Interval	A measurement where the difference between two values is meaningful, such that equal differences between values correspond to real differences between the quantities that the scale measures (for example temperature)

Rate question:

Next question

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Question 118 of 131

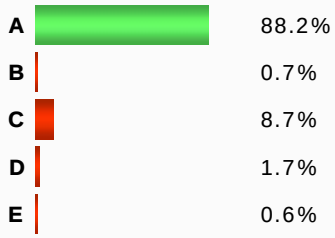
What is the correct formula to calculate the negative predictive value of a screening test?

TP = true positive; FP = false positive; TN = true negative; FN = false negative

- ✓ A. TN / (TN + FN)
- B. TP / (TP + FP)
- C. TN / (TN + FP)
- D. Sensitivity / (1 - specificity)
- E. TP / (TP + FN)

Next question

Question stats



88.2% of users answered this question correctly

Session score = 6.8%

RCGP curriculum

3.5 - Evidence-based Practice

Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 119 of 131

A small study looks at the weight of patients diagnosed with type 2 diabetes mellitus. Overall 64 patients were reviewed. The average weight was 81 kg, with a standard deviation of 12 kg. What is the standard error of the mean?

- A. Square root (64 / 12)
- B. Square root (81 / 12)
- C. 12 / 9
- D. 9 / 12
- ✓ E. 1.5

Next question

Standard error of the mean = standard deviation / square root (number of patients)

The standard error of the mean is calculated by the standard deviation / square root (number of patients)

= 12 / square root (64) = 12 / 8 = 1.5

Standard error of the mean

The standard error of the mean (SEM) is a measure of the spread expected for the mean of the observations - i.e. how 'accurate' the calculated sample mean is from the true population mean

Key point

- SEM = SD / square root (n)
- where SD = standard deviation and n = sample size

Therefore the SEM gets smaller as the sample size (n) increases

A confidence interval for the mean can be calculated in a similar way to that for a single observation, i.e. The 95% confidence interval:

- lower limit = mean - (1.96 *SEM)
- upper limit = mean + (1.96 * SEM)

Rate question:

Next question

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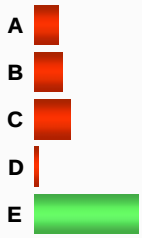
Question stats



53.1% of users answered this question correctly

Session score = 6.7%

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Curriculum statement

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Question 120 of 131

A study looks at the use of amoxicillin in the treatment of acute sinusitis compared to placebo. The following results are obtained:

	Total number of patients	Number who achieved resolution of symptoms at 7 days
Amoxicillin	100	60
Placebo	75	30

What is the odds ratio a patient achieving resolution of symptoms at 7 days if they take amoxicillin compared to placebo?

- A. 1.5
- B. 0.5
- ✓ C. 2.25
- D. 0.6
- E. 1.66

Next question

Odds - remember a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome

NOT a ratio of the number of people who incur a particular outcome to the total number of people

The odds of symptoms resolution with amoxicillin = 60 / 40 = 1.5

The odds of symptoms resolution with placebo = 30 / 45 = (2/3)

Therefore the odds ratio = 1.5 / (2/3) = 2.25

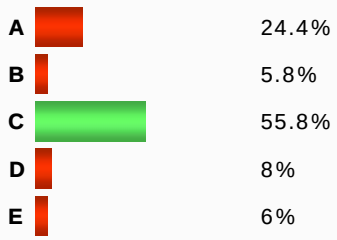
Odds and odds ratio

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

Question stats



55.8% of users answered this question correctly

Session score = 6.7%

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	Total number of patients	Achieved = 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol = 40 / 20 = 2

The odds of achieving significant pain relief with placebo = 30 / 60 = 0.5

Therefore the odds ratio = 2 / 0.5 = 4

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Next question

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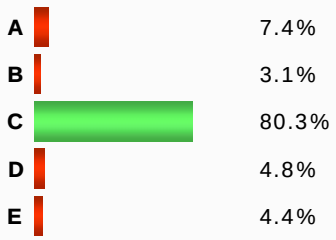
Question 121 of 131

A new biochemical marker has been found which is increased in mothers who are carrying fetuses with Down's syndrome. The new blood test is trialled in 1,000 women over the age of 35 years. Of these women 20 were found to be carrying a fetus with Down's syndrome as assessed using standard measures. The new test was positive in 15 of the 20 cases but was also positive in 30 of the remaining 980 women. What is the positive predictive value of the test?

- A. 0.66
- B. 950/980
- ✓ C. 0.33
- D. 0.8
- E. 0.5

Next question

Question stats



80.3% of users answered this question correctly

Session score = 6.6%

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3.5 - Evidence-based Practice

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A contingency table can be constructed from the above data, as shown below:

	Down's	Not Down's
Test positive	15	30
Test negative	5	950

Positive predictive value = TP / (TP + FP) = 15 / (15 + 30) = 0.33

Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result

Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

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Question 122 of 131

A study looks at whether a new oral treatment for patients with heart failure can prevent hospital admissions. When reviewing the data how should it be decided if the study was statistically significant?

- A. p-value < 2 standard deviates from mean
- B. p-value < (1 - type II error)
- ✓ C. p-value < significance level
- D. p-value < power
- E. p-value < 0.05

Next question

Question stats

A	2.8%
B	8.6%
C	26.5%
D	2%
E	60%

26.5% of users answered this question correctly

Session score = 6.6%

The significance level of a test is defined as the probability of rejecting the null hypothesis when the null hypothesis is actually true (a Type I error). It is often represented by the Greek symbol alpha.

A study is only statistically significant if the p-value reaches the significance level set before the study is started. Popular levels of significance are 5% (0.05), 1% (0.01) and 0.1% (0.001).

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Curriculum statement

Significance tests

A null hypothesis (H_0) states that two treatments are equally effective (and is hence negatively phrased). A significance test uses the sample data to assess how likely the null hypothesis is to be correct.

For example:

- 'there is no difference in the prevalence of colorectal cancer in patients taking low-dose aspirin compared to those who are not'

The alternative hypothesis (H_1) is the opposite of the null hypothesis, i.e. There is a difference between the two treatments

The **p value** is the probability of obtaining a result by chance at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. It is therefore equal to the chance of making a type I error (see below).

Two types of errors may occur when testing the null hypothesis

- type I: the null hypothesis is rejected when it is true - i.e. Showing a difference between two groups when it doesn't exist, a false positive. This is determined against a preset significance level (termed alpha). As the significance level is determined in advance the chance of making a type I error is not affected by sample size. It is however increased if the number of end-points are increased. For example if a study has 20 end-points it is likely one of these will be reached, just by chance.
- type II: the null hypothesis is accepted when it is false - i.e. Failing to spot

a difference when one really exists, a false negative. The probability of making a type II error is termed beta. It is determined by both sample size and alpha

	Study accepts H_0	**Study rejects H_0**
Reality H_0		Type 1 error (alpha)
Reality H_1	Type 2 error (beta)	Power (1 - beta)

The power of a study is the probability of (correctly) rejecting the null hypothesis when it is false

- power = 1 - the probability of a type II error
- power can be increased by increasing the sample size

Rate question:

Next question

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Question 123 of 131

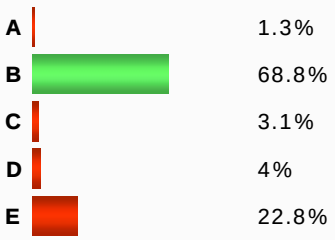
A case-control study is being designed to look at the relationship between epilepsy and a new vaccine for varicella. What is the usual outcome measure in a case-control study?

- A. Numbers needed to harm
- ✓ B. Odds ratio
- C. Experimental event rate
- D. Absolute risk increase
- E. Relative risk

Next question

Case-control studies - odds ratio

Question stats



68.8% of users answered this question correctly

Session score = 6.5%

RCGP curriculum

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Study design

The following table highlights the main features of the main types of study:

Randomised controlled trial	Participants randomly allocated to intervention or control group (e.g. standard treatment or placebo) • Practical or ethical problems may limit use
Cohort study	Observational and prospective. Two (or more) are selected according to their exposure to a particular agent (e.g. medicine, toxin) and followed up to see how many develop a disease or other outcome. The usual outcome measure is the relative risk. • Examples include Framingham Heart Study
Case-control study	Observational and retrospective. Patients with a particular condition (cases) are identified and matched with controls. Data is then collected on past exposure to a possible causal agent for the condition. The usual outcome measure is the odds ratio. • Inexpensive, produce quick results • Useful for studying rare conditions • Prone to confounding
Cross-sectional survey	Provide a 'snapshot', sometimes called prevalence studies • Provide weak evidence of cause and effect

Rate question:

Next question

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Questions 124 to 126 of 131

Theme: Screening test statistics

A Specificity
B Relative risk
C Absolute risk reduction
D Sensitivity
E Negative predictive value
F Odds ratio
G Likelihood ratio for a positive test result
H Positive predictive value
I Likelihood ratio for a negative test result
J Relative risk reduction

Please select the statistical term that each phrase describes:

124. The chance that the patient does not have the condition if the diagnostic test is negative

Specificity

The correct answer is Negative predictive value

125. Proportion of patients with the condition who have a positive test result

Specificity

The correct answer is Sensitivity

126. How much the odds of the disease decrease when a test is negative

Specificity

The correct answer is Likelihood ratio for a negative test result

Next question

Question stats

Average score for registered users:

124	57.4%
125	65.7%
126	74.6%

Session score = 6.3%

RCGP curriculum

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Curriculum statement

Screening test statistics

It would be unusual for a medical exam not to feature a question based around

screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	**Disease absent**
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive value	TN / (TN + FN)	The chance that the patient does not have the condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

Rate question:

Next question

Comment on this question

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Question 127 of 131

The average weight loss of a patient following a new type of bariatric surgery is 18 kg. The standard deviation of weight loss is 3kg. Assuming the weight loss is normally distributed, what percentage of patients will loss between 9 and 27 kg?

- A. 97.4%
- B. 95%
- C. 95.4%
- D. 68.3%
- ✓ E. 99.7%

Next question

99.7% of values of a normally distributed variable lie within 3 standard deviations of the mean.

Normal distribution

The normal distribution is also normal as Gaussian distribution or 'bell-shaped' distribution. It describes the spread of many biological and clinical measurements

Properties of the Normal distribution

- symmetrical i.e. mean = mode = median
- 68.3% of values lie within 1 SD of the mean
- 95.4% of values lie within 2 SD of the mean
- 99.7% of values lie within 3 SD of the mean
- this is often reversed, so that within 1.96 SD of the mean lie 95% of the sample values
- the range of the mean - (1.96 *SD) to the mean + (1.96 * SD) is called the 95% confidence interval, i.e. if a repeat sample of 100 observations are taken from the same group 95 of them would be expected to lie in that range

Standard deviation

- the standard deviation (SD) represents the average difference each observation in a sample lies from the sample mean
- SD = square root (variance)

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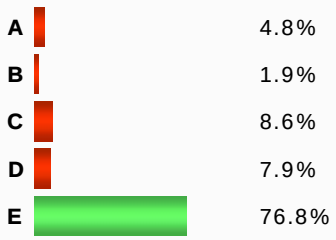
Question stats



76.8% of users answered this question correctly

Session score = 6.3%

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3.5 - Evidence-based Practice

Curriculum statement

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Question 128 of 131

A contingency table is constructed for a new blood protein marker to screen for prostate cancer in men aged between 50 and 70 years:

	Prostate cancer present	Prostate cancer absent
New test positive	19	20
New test negative	14	723

What is the positive predictive value of the new test?

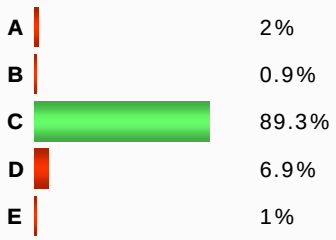
- A. 19/20
- B. 723/743
- ✓ C. 19/39
- D. 19/33
- E. 723/737

Next question

Positive predictive value = true positives / (true positives + false positives)

= 19 / (19 + 20)

Question stats



89.3% of users answered this question correctly

Session score = 6.3%

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Screening test statistics

It would be unusual for a medical exam not to feature a question based around screening test statistics. The available data should be used to construct a contingency table as below:

TP = true positive; FP = false positive; TN = true negative; FN = false negative

	Disease present	Disease absent
Test positive	TP	FP
Test negative	FN	TN

The table below lists the main statistical terms used in relation to screening tests:

Sensitivity	TP / (TP + FN)	Proportion of patients with the condition who have a positive test result
Specificity	TN / (TN + FP)	Proportion of patients without the condition who have a negative test result
Positive predictive value	TP / (TP + FP)	The chance that the patient has the condition if the diagnostic test is positive
Negative predictive	TN / (TN +	The chance that the patient does not have the

value	FN)	condition if the diagnostic test is negative
Likelihood ratio for a positive test result	sensitivity / (1 - specificity)	How much the odds of the disease increase when a test is positive
Likelihood ratio for a negative test result	(1 - sensitivity) / specificity	How much the odds of the disease decrease when a test is negative

Positive and negative predictive values are prevalence dependent. Likelihood ratios are not prevalence dependent

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Question 129 of 131

Which one of the following best describes the characteristics of a positively skewed distribution?

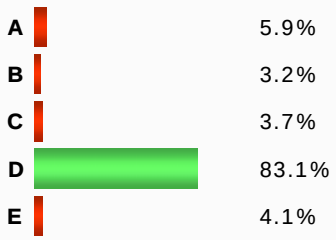
- A. Mode > mean > median
- B. Median > mean > mode
- C. Median > mode > mean
- ✓ D. Mean > median > mode
- E. Mean > mode > median

Next question

Skewed distributions

- alphabetical order: mean - median - mode
- '>' for positive, '<' for negative

Question stats



83.1% of users answered this question correctly

Session score = 6.2%

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Skewed distributions

Normal distributions: mean = median = mode

Positively skewed distribution: mean > median > mode

Negatively skewed distribution mean < median < mode

To remember the above note how they are in alphabetical order, think positive going forward with '>', whilst negative going backwards '<'

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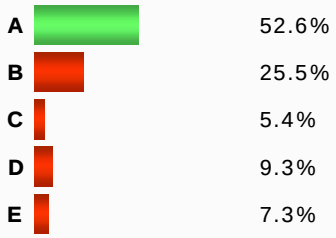
Question 130 of 131

Which type of bias are case-control studies particularly prone to?

- ✓ A. Recall bias
- B. Omitted-variable bias
- C. Publication bias
- D. Expectation bias
- E. Work-up bias

Next question

Question stats



52.6% of users answered this question correctly

Session score = 6.2%

Bias

Bias describes the situation in a trial where one outcome is systematically favoured. A number of different types of bias are recognised:

Selection bias	Error in assigning individuals to groups leading to differences which may influence outcome. Subtypes include **sampling bias** where the subjects are not representative of the population. This may be due to **volunteer bias**. An example of volunteer bias would be a study looking at the prevalence of *Chlamydia* in the student population. Students who are at risk of *Chlamydia* may be more, or less, likely to participate in the study. A similar concept is **non-responder bias**. If a survey on dietary habits was sent out in the post to random households it is likely that the people who didn't respond would have poorer diets than those who did.
Publication bias	Failure to publish results from valid studies, often as they showed a negative or uninteresting result. Important in meta-analyses where studies showing negative results may be excluded.
Work-up bias (verification bias)	Mainly seen in studies trying to validate a new diagnostic test. Refers to the gold-standard diagnostic test being done more frequently in patients who have already had a positive new test.
Expectation bias	Only a problem in non-blinded trials. Observers may subconsciously measure or report data in a way that favours the expected study outcome.
Recall bias	A particular problem in case-control studies.

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Question 131 of 131

A new adjuvant treatment for women with breast cancer is investigated. The study looks at the recurrence rate after 5 years. The following data is obtained:

	Number of patients	Number who had a recurrence within a 5 year period
New drug	200	40
Placebo	400	100

What is the relative risk reduction?

- A. 50%
- ✓ B. 20%
- C. 4
- D. 0.8
- E. 5%

End session

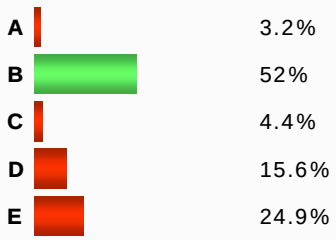
Relative risk reduction = (EER - CER) / CER

Experimental event rate, EER = 40 / 200 = 0.2

Control event rate, CER = 100 / 400 = 0.25

Relative risk reduction = (EER - CER) / CER = (0.2 - 0.25) / 0.25 = -0.2 or a 20% reduction

Question stats



52% of users answered this question correctly

Session score = 6.1%

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Curriculum statement

Relative risk

Relative risk (RR) is the ratio of risk in the experimental group (experimental event rate, EER) to risk in the control group (control event rate, CER)

To recap

- EER = rate at which events occur in the experimental group
- CER = rate at which events occur in the control group

For example, if we look at a trial comparing the use of paracetamol for dysmenorrhoea compared to placebo we may get the following results

	Total number of patients	Experienced significant pain relief
Paracetamol	100	60

Placebo	80	20

Experimental event rate, EER = 60 / 100 = 0.6

Control event rate, CER = 20 / 80 = 0.25

Therefore the relative risk = EER / CER = 0.6 / 0.25 = 2.4

If the risk ratio is > 1 then the rate of an event (in this case experiencing significant pain relief) is increased compared to controls. It is therefore appropriate to calculate the relative risk increase if necessary (see below).

If the risk ratio is < 1 then the rate of an event is decreased compared to controls. The relative risk reduction should therefore be calculated (see below).

Relative risk reduction (RRR) or **relative risk increase (RRI)** is calculated by dividing the absolute risk change by the control event rate

Using the above data, RRI = (EER - CER) / CER = (0.6 - 0.25) / 0.25 = 1.4 = 140%

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